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Aluminium Fixtures.

WHY is it that so beautiful a material as aluminium is not more freely utilized for electric light fixtures and similar artistic castings? In speculating on the magnificent opportunities for aluminium in various lines of work the attention of the public seems to have been unnecessarily drawn toward its use in heavy engineering work and in general as a substitute for steel, rather than for bronze. The great beauty of the material, its freedom from tarnishing, and its extreme lightness, are strong points in favor of its use in decorative work. For electroliers and similar artistic objects the pure metal is beautifully adapted. It can now be cast very successfully and where casting is impracticable the softness of the metal, a marked objection to its use for certain purposes, enables tool work to be executed upon it with the greatest ease. In a large class of ornamental work where the cost of the material is comparatively slight compared with that of the labor spent upon it, the substitution of aluminium for bronze would not increase the price of the finished product to a prohibitive extent and would put a novel and peculiarly elegant material in the hands of our art designers. Something has already been done in this line, but the field is as yet comparatively unoccupied, although extensive enough to furnish a market for all the aluminium that the existing works can produce. Perhaps the alloy of aluminium with a very small quantity of silver would be most effective in cases where wearing properties are necessary. If once some enterprising manufacturer in this country were to bring before the public aluminium art castings on a considerable scale he would establish at once a new industry and swiftly reap the benefits of it.

Station Management.

ELSEWHERE in our pages Mr. J. R. Cravath gives a few useful hints on the management of alternating current stations, dealing especially with the subject of regulation. One point mentioned it is well to bring to the minds of our readers again, although we have discussed it not infrequently in these pages, that is, the use of large transformers. The bigger a transformer, at least within practical limits, the higher efficiency and better regulation can be obtained from it, and this fact alone is sufficient reason for employing the larger sizes. Other very practical advantages are the smaller cost of installation, fewer transformers to care for, and a more nearly uniform load; all these are favorable to high station efficiency. We have quite a little yet tolearn regarding the employment of the alternating current system; it has developed much further abroad than in this country, and practice there is quite a different matter from our own. For example, alternators are very frequently worked in parallel, a method of operation rarely or never used here. Transformers are likewise more often run in parallel, and larger transformer units are in much more common use. The frequency employed is decidedly less than here, only about three-fifths as great, and synchronous motors are far more freely used. A few years will doubtless see great changes in alternating current work, both here and abroad, and meanwhile we should do well not to despise the experience of others about to keep a watchful eye on foreign methods and their results with a view to utilizing whatever is available in them.

Profits of Central Stations.

A PAPER which will prove of value to central station managers is Prof. W. D. Marks' discussion of some of the commercial features of electric lighting published in our columns this week. It is a practical paper intended to deal with every-day problems, and was read before the Association of Edison Illuminating Companies a few weeks since. The paper is largely the result of the experience in the Philadelphia Edison station, where the policy was boldly taken of meeting the price of gas, although it brought down the price of 16-c. p. lights to three-fourths of a cent per lamp hour. The result has proved on the whole satisfactory, and although perhaps the results could not be duplicated in very many places the example is worthy of emulation. It is certainly most encouraging to find that the electric lighting station can compete with gas on even terms and pay dividends, even where the price of gas is as low as $1.50 per thousand feet. Prof. Marks strongly advocates supplying by meter, on the ground that in the long run it pays better than by contract and diminishes any tendency to rapid overloading of the station. One interesting series of facts brought out is the relative profit to be obtained from different classes of consumers; at one end of the line stand restaurants and gambling houses, at the other—the least profitable end—dwelling houses and churches. Motor service has proved to be advantageous, even though a less rate is paid than for lighting. Altogether Prof. Marks' paper contains a great deal of exceedingly practical and valuable information, the more important as it represents the results of experience on a very large scale.

The Search Light Again.

A BRIEF note in our columns this week gives the opinion of a well-known naval authority on the search light question, which was discussed from the optical standpoint by Mr. Boyle in our columns last week. The writer calls attention to the fact that by means now very generally adopted in search lights, a very large proportion of light is thrown in the direction of the reflector. This is often accomplished by staggering the carbons so that the negative is thrown slightly nearer the reflector than the positive; the result is a crater not pointing downward but obliquely backward, and, as the crater is the principal source of light, a considerable proportion of the luminous radiation is sent in the general direction of the reflector. Our naval friend estimates this proportion at as high as 90 per cent.; we are not aware that any exact measurements have ever been made, but the general adoption of the practice in search light work and, indeed, in the use of the electric arc for stereopticons and the like, gives sufficient evidence of its practical usefulness. Still, even with this device there is undoubtedly a considerable amount of light lost, for even supposing that the face of the crater were presented directly to the reflector, which it is not, the effective radiation is certain to subtend a considerably larger spherical angle than the reflector used in most of our present search lights. A deeper parabolic mirror would pick up considerably more light even were the subsidiary reflector proposed by Mr. Boyle unnecessary. It is highly desirable to stir up the question, for it is only by such a process of mild agitation that the best general results can be attained.

The Deadly Cable.

ALTHOUGH the Broadway cable road is as yet unfinished, the power stations are not built, the conduits not completed and the streets still being torn up by workmen, to the great inconvenience of everybody, the cable road has already begun in a small but suggestive way its career of mischievousness. It took its first step in this direction on Sunday last by twisting the wheel off a dog cart driven by a well known man about town as neatly and deftly as though it had been long running and were hardened in iniquity, instead of being not yet ready for operation. Even though the cable is not laid and the cars are not ready to run over pedestrians and vehicles, the slot is quietly laying in wait for passers by, and yet we do not consider the cable road an outcast on this account. Imagine the result, however, had the offender been an electric conduit instead of one for the peaceful cable; we should have been treated to a lurid description of the deadly current proceeding from unlaid wires, springing from its lair in the conduit to wind itself about the unoffending spokes of a passing wheel and tearing it off the vehicle, to hurl it on the sidewalk amid the blaze of many-colored lightnings and the smell of brimstone. We should be treated to anathemas launched against the electric current, existent or non-existent, in terms the severest to be found in any reputable vocabulary, and yet we wonder whether a little more experience with the cable will not teach the public to deal with it less tenderly and with electricity more patiently. The history of any cable road makes good missionary literature for the accident insurance companies, and unless the Broadway cable is followed by more than the almost providential good fortune of the elevated roads its experience will be no more innocent than is usual.

High Tension Experiments.

WE extract this week from one of the foreign journals an account of the valuable series of experiments carried out very recently by Messrs. Siemens Brothers, of London. They were in the line pointed out by the Lauffen-Frankfort experiments—the use of enormous voltages for the transmission of power. Forty-five thousand volts was reached in some of the various tests with the most successful and striking results. The difficulty of insulating these prodigious electromotive forces is very serious, as at the figure last named the arc will flash across four or five inches of air with the greatest freedom, streaming through it almost as easily as a spark from an induction coil through a Geissler tube. The static strain produced is of the most formidable character, and some of the experiments performed remind one strikingly of those shown in Mr. Tesla's beautiful lecture before the American Institute of Electrical Engineers. Fascinating as the experiments are and elegant as is the solution of the transmission of power problem which they furnish, the point must come sooner or later when finite insulation will refuse to stand the strain. The limit is certainly not reached in the Lauffen experiments, although even there serious trouble arose from the puncturing of porcelain insulators. At 30,000 or 40,000 volts the difficulties become enormously enhanced, for, so far at least as air is concerned, at these extraordinary pressures the dielectric strength seems to be rapidly reduced. Were it possible to work under cover perhaps even 50,000 volts might prove commercially available, but difficulties multiply as soon as the conductors are exposed to the weather. Still, the use of high tension currents is in its infancy at present, and the practical limit of electromotive force is certain to be raised far above anything now in use. Just how high it can be carried experience only can tell.

Electric Accumulators.

ON another page is given quite a complete account of a large series of foreign accumulators. The accumulator has for the most part been developed on the other side of the water and is used far more there than here, so that such information as is contained in Mr. Hering's article is doubly useful to us in America. The curve published with it is most instructive and should be commended to the careful attention of every body who has to deal with the practical accumulator. It simply shows the decrease of working capacity and hence of efficiency that follows an increase in discharge rate. The capacity of an accumulator is never independent of the rate of charge and discharge, and in this fact we find a most serious difficulty when an attempt is made to utilize a storage battery for work such as electric traction, where a high output is desirable in order to reduce the weight of the accumulators. The chemical action in any case of this kind is never completely reversible, the less so, apparently, as effort is made to hasten it. The curve shown is from a well known and substantial accumulator of the better class, and though it represents only the results obtained from a single pair of plates it is none the less instructive on this account. It will be noted that so long as the discharge rate is very low the capacity varies but slightly with it, while with any attempt to force the discharge rate the efficiency of the battery falls immediately and seriously. Curves of this sort are not familiar to most electricians, although they have been obtained by very many of those who have worked practically with accumulators. They will, of course, vary quite widely with the physical character of the plates, but will show always the same evil characteristic of lessened capacity at higher rates of output. In certain types the curve becomes almost a slanting straight line, in all it approximates to a horizontal line at exceedingly low discharge rates, but falls away from it with greater and greater rapidity as the current density increases. One fact especially to be noted is that the foreign accumulators as a rule are heavy, intended to be worked at a low and consequently efficient discharge rate. Three ampère hours per pound of plates appears to be about a normal capacity; a condition of things well enough for stationary work, but somewhat forbidding if the cells are to be used for traction.

Latest Foreign Electrical News.

(By Cable from Our Own Correspondent.)

London, Nov. 16, 1891.—The Thomson-Houston electric tramway at Leeds, the opening of which I have mentioned in several messages, was officially inspected on Tuesday last, and the result on the whole was highly satisfactory. The cars were severely tested, and with a few minor exceptions every detail of their performance met with approval. The line was also visited by members of the syndicate now engaged in working Wiegand steam tramways. They investigated the Leeds line very thoroughly, with the idea of substituting electricity for steam in works they have in hand.

The Leicester municipality propose to follow the example of the Cork municipality in adopting the gas engine substation system of electric lighting, the gas to be furnished from the mains to a number of small plants in convenient distributing centres.

There has recently been a considerable amount of trouble at the great Deptford station. Since Mr. Ferranti left there have been several annoying accidents, not very serious in themselves but still affecting the regularity of the current supply in a somewhat disastrous way.

The Glasgow municipality, after a long and laborious investigation and even more deliberation than usually characterizes such bodies, has decided by a vote of 50 to 6 to take into municipal control the tramway system of the city when the present lease expires. It is highly probable that the motive power adopted will be electricity.

The annual dinner of the Institution of Electrical Engineers occurred on Friday evening last; the attendance was large, and Prof. Crookes, president of the Institution, made a fine speech, in which he discussed the infinite field of research now open to electricians, and among other things alluded in the most appreciative way to Mr. Nikola Tesla's recent investigations.

NEW BOOK.

The Electromagnet. By Prof. Silvanus P. Thompson. Pp. 450. 213 Ills. E. & F. N. Spon. London, 1891. Price $6.00.

This volume is an amplification of Prof. Thompson's "Lectures on the Electromagnet," which has already been published in this country. It contains in addition to his work on electromagnet mechanisms a chapter on the applications of the electromagnet in surgery, and is most profusely illustrated. Of its value there is little need to speak here; it is a complete treatise on the subject, and is of great value to those who have occasion to do electromagnetic designing.

Regulation in Alternate Current Work.

BY J. R. CRAVATH.

The excellent series of papers by Prof. Roberts, published in The Electrical World some weeks ago, brings to mind a few points in regard to regulation which it would be well to impress on the minds of electric light men.

The necessity of paying careful attention to the regulation of a constant potential system is generally, from the nature of the case, felt more with direct than with alternating systems. I think it is safe to say that many of the stations now using the alternating system run on the plan of keeping the primary station voltage constant without regard to the load; and that at least some manufacturers wink at this state of affairs is shown by the fact that station pressure indicators have been turned out for use with a certain company's alternating apparatus on which the scale consists of a simple scratch, at which point "tradition says" the voltage should be kept. A direct current station run on this principle of keeping the station voltage constant for all loads would (unless the line loss was smaller than it ever is in practice) soon have to quit the business on account of the lamp breakage during light loads. It is only because the loss between dynamo and lamps is comparatively smaller in the alternating system that superintendents are not forced to be more careful about their regulation. The industry has now come to the position that the small things count for more than formerly, and we cannot be too careful.

Assuming that a full load drop of two per cent. is allowed in the primary mains, two per cent. in the transformer and two per cent. in the secondary mains (this is a perfectly fair every-day case), then with constant primary station voltage the maximum variation possible on any secondary is six per cent. at the lamps! Supposing that the load on any transformer varies as does the entire load of the system from full to one-sixth load at different hours of the day, the regulation on that transformer can, of course, then be perfectly effected by dropping the station voltage five per cent. at light load.

And here comes in the real problem, viz., how to distribute the loads on the various transformers so that the load on one transformer will correspond approximately with that on the whole system. Of course to do this we must do a good deal of planning, and there is more carelessness in this respect than in any other. The constructing engineer is apt to be above such work or think it not worth attention, and it is a pretty universal custom (outside of the large plants under regular engineers) to cut in a transformer wherever and whenever more lights are wanted.

It will generally cost a little more work to distribute the transformer loads according to a system, but it can be done and pays abundantly on account of the better regulation possible, and any experienced station manager knows what good regulation means. The use of large transformers will help greatly by bringing different classes of customers on one secondary so that there will be some all-night lamps on each transformer. This, as well as the greater efficiency of large transformers, has induced wide-awake superintendents to begin to use the larger sizes, for although it is yet to be proved that they are in themselves better regulated, yet, as I have shown, better regulation is possible with them if they are properly loaded to correspond with the loads on other transformers of the system.

The main difficulty comes with the lighting of residences and very much scattered buildings, where each house must have its transformer which is fully loaded only on special occasions. It is generally advisable in such cases to wire the secondaries so that the lamp voltage is normal when the transformer is half loaded, rather than run the few lamps that constitute the regular load at five or six per cent. above normal for 350 nights in the year in order to have the voltage exactly right the other 15. The plan proposed would limit the variation at the lamps to within two per cent. of normal, which is as near as we get with ordinary commercial instruments. It would help electric light men if a better knowledge was had of the transformers they use, and I hope the day is not far distant when more extensive data will be furnished with each transformer than its capacity in "16 c. p. lamps." There are hundreds of the smaller and moderate sized alternating current stations over the country which can profit by the observance of more system in their load distribution.

Electric Search Lights.

BY "A NAVAL OFFICER."

The Electrical World for the 14th inst. contained an article on Electric Search Lights, by Mr. C. B. Boyle. While it principally concerns the merchant marine, he has also seen fit to include the navy.

Now, any device which will tend to utilize more of the radiant light from the arc is in the line of progress and is to be commended, but in so doing your correspondent has fallen into a grave error. He evidently assumes that the greater portion of the light is derived from the arc flame, instead of the crater, whereas the reverse is the case. It is at the crater surface where the temperature, and consequently the luminous effects, are so great, the light from which, in the naval projectors, is thrown directly on the Mangin reflectors. The flame light, on the contrary, is comparatively feeble and of a purple quality.

Roughly speaking, nine-tenths of the light of a 45-volt arc lamp emanates directly from the incandescent crater, the lamp alone being considered, without any projection. Allowing, then, as your correspondent states, that with the present projecting apparatus nine-tenths of the light from the arc is lost, this would represent but nine per cent. of the energy required for the lamp.

I take the liberty to express my views in order that the readers of The Electrical World may not be led to believe that our search light apparatus is an optical failure, as represented, but on the contrary is most efficient, and utilizes in a projected and almost parallel beam the greater part, by far, of the radiant light.

Report of the Delegates Sent by the American Institute of Electrical Engineers to the International Congress of Electricians.

The following is an abstract of the report of the delegation to the Council of the American Institute of Electrical Engineers, as made by Carl Hering, chairman:

Of the members of your delegation the following were present during the whole session of the congress, viz.: Mr. L. Gutmann, Prof. Heinrich, Mr. Carl Hering and Prof. Nichols. The only member not present was Mr. Tesla, whose unavoidable absence is to be regretted very much.

Your delegates had received no definite directions regarding matters to be brought before the congress, the choice of which was, therefore, left entirely to them. They concluded to bring up two or three matters which had occupied the attention of the institute, namely, the adoption of the name "henry" and a normal value for the resistance of copper, and in addition suggest the adoption of a practical unit of magnetism.

The substance of our propositions as duly announced on the printed programmes was as follows:

1. That the American Institute of Electrical Engineers had adopted the name "henry" for the name of the practical unit of induction and that we propose that this congress formally adopt the name. This was followed by an explanation of the value of this unit, why this name was preferred to the word "quadrant," and why it was named after Prof. Henry.

2. That this congress ought to adopt a name and value for a practical unit of the intensity of magnetism. To open a discussion we proposed the name "gauss" and a value of 1,000 per square centimetre, or 10^3 absolute units.

3. That it would be desirable to adopt a normal value for the resistance of copper to facilitate relative comparisons for commercial purposes. To this we added that we wished merely to agitate this question here in order that any preliminary tests to determine such a value may be made between now and the next congress, so as to facilitate its adoption at that congress.

4. The announcement closed with an invitation to the members of this congress, on the part of the American Institute of Electrical Engineers, to participate in the next international congress, to be held under the auspices of this Institute, in Chicago in 1893. (At that time your delegates were not informed that this coming congress was in the hands of a committee of the World's Fair.)

There were other matters which your delegates might have added, but it was thought best under the circumstances to limit ourselves to only the most important.

Seeing that there were decided differences of opinion among some of the prominent foreign members of the congress as to whether the most important magnetic unit to be named was the unit of intensity or one of quantity (flux), the chairman of the delegation added the suggestion that both be named, and proposed the name "weber" for the latter.

When the consideration of our proposition came up at the general session, it was referred—together with the proposition of Mr. Hospitalier to establish a uniform international system of notation and conventional signs and symbols—to a special committee, to report at the next general session. This committee was appointed by the chair, and consisted of Prof. Ferraris, chairman; Mr. Hering, secretary, and a list of members of which the following were present at the meetings: Braun, Grawinkel, W. Kohlrausch, Loewenherz, Strecker, Uppenborn (Germany); Ayrton, Preece, Silvanus Thompson (England); Ferraris, Roiti (Italy); Hering, Nichols (United States); Hospitalier (France); Weber (Switzerland).

The programme of the congress provided for almost every hour, so that there was only very little time left (two meetings of an hour each) for the meetings of this committee. Mr. Hospitalier's proposition occupied almost the whole time at these meetings, leaving only a very short time for the consideration of our propositions. The English members appeared to favor the adoption of the name "henry," Mr. Preece saying that he had received instructions from the Royal Society to advocate its adoption. The German, French and Swiss members opposed it on various grounds. Some thought it conflicted with the already adopted name, "quadrant;" others thought it ought to be "franklin;" others "neumann," and some did not acknowledge the work of Prof. Henry in this field. Quite a number had never heard of its adoption by this institute. The names gauss and weber for the magnetic units appeared to meet with general approval. The disagreement was as to what numerical values should be. It appeared to be preferred to make them both 10^8 absolute units. The matter of the normal resistance of copper did not come up at all, for want of time.

It was suggested that these subjects were too important to be considered hastily during the few minutes which were left for this meeting. It was thought better not to do anything than to do something which might afterward be regretted. For these reasons and seeing that this committee (for want of time for preparation) was entirely unprepared to discuss the subjects, our propositions were withdrawn. Had there been sufficient time for proper consideration, I think there is little doubt that our propositions would all have been adopted, except that of the normal resistance for copper, which number the Germans have no use for, because they usually express the quality of copper by the conductivity of a unit of length and cross-section.

Although our propositions were not adopted, chiefly on account of lack of time, the effect of our making them has prepared the way for their adoption at the next congress. I would suggest that the institute profit by this experience, and that, as the leading American electrical society, it ought to take the lead in the matter of establishing and naming practical magnetic units and other similar international matters, by considering the subject now at their meetings, making propositions, publishing them in domestic and foreign journals, inviting the aid and criticism of foreign electricians and societies, and in this way prepare for their final settlement at the next congress. A congress is hardly the place to start a discussion on such matters; it is the place to finally settle a discussion which should precede it in the societies and journals of the leading nations.

In this connection I would call the attention of the institute to the important matter of a universal and international system of notation and electrical symbols. This subject was very ably discussed in a paper read before the congress by Mr. Hospitalier, who has for years given the subject much attention and has formulated a complete system, parts of which were adopted at this congress. The committee named above were instructed by the congress to discuss the subject between now and the next congress and bring it to the notice of the public through the journals so as to facilitate the adoption of some such system at the next congress. I would suggest that this institute take up the matter in this country and that it take a leading part in soliciting opinions and criticisms from others; also that

this be done as soon as possible, as the question of an international system will not be an easy one to settle.

It is in place here to call the attention of this institute, as a promoter of the next international congress, to one of the faults of this congress. There appears to have been no preparation made for international business; besides the social part of the programme, which was very creditably arranged and was highly enjoyable, there was nothing else but the reading of papers, and of these a number were of such a character that it would have been better to have read them by title, or, at least, at special meetings designed for such papers. It would have been better if all papers had been passed upon, beforehand, by a competent committee and classed by them, preference being given in time and place on the programme in accordance with their merits and general interest. A congress which people visit from all parts of the world is hardly the place to spend much time in a lengthy description of a new piece of apparatus, a proposed invention, priority of inventions, etc.

In conclusion I wish to add that the high standing of the institute in Germany was shown by the great kindness and courtesy extended to your delegates. There was nothing left undone by the managing committee to show their appreciation of the high standing of the institute and to recognize the part it took by sending a delegation to the congress. The institute will receive a copy of the proceedings when published. It was also presented with a photograph of the original of an interesting letter of the year 1830, by Gauss, describing one of the first electric telegraphs.

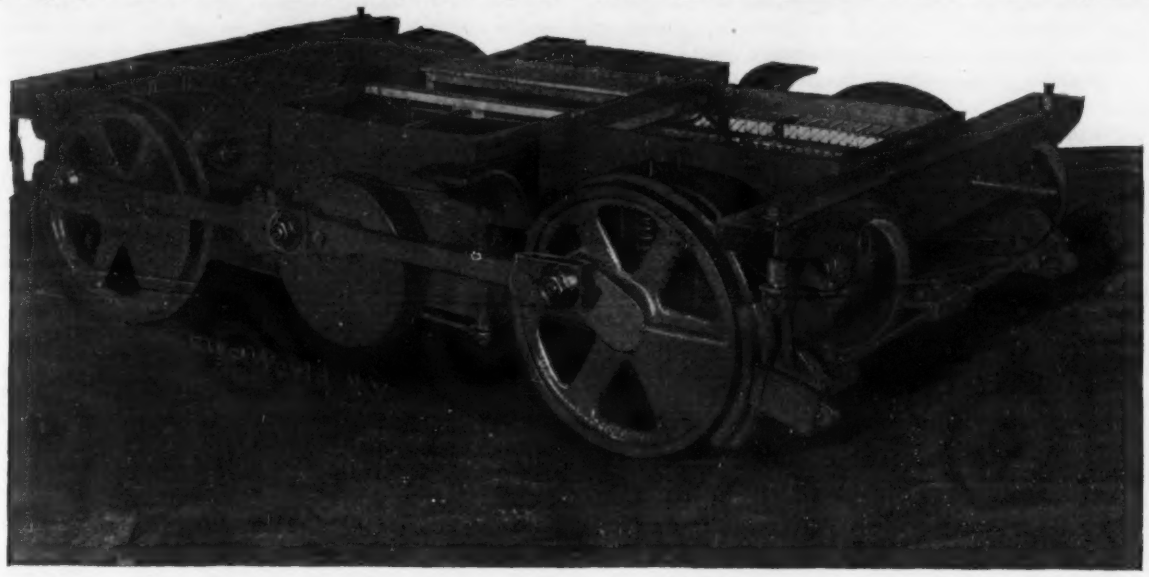


FIG. 1.—A GEARLESS, DIRECT CONNECTED MOTOR.

Experiments with High Tension Currents.*

At the Frankfort Exhibition a number of very beautiful experiments were carried out by Messrs. Siemens & Halske with alternating currents of high electromotive force. These were performed by Dr. Berliner, and excited the admiration of all who saw them. The region of alternate currents of great potential is almost unexplored, but the researches that have been made show that it is full of possibilities of which no one can yet form any accurate conception. At present we are only on the verge of the subject, which is so encircled with practical difficulties that no systematic experimental inquiries have been made. The few phenomena which have been shown have been so brilliant, and withal so unexpected, that an intense curiosity has been evoked for further information, and many minds turned to the subject. While Messrs. Siemens & Halske were delighting their friends with exhibitions reaching up to 20,000 volts, Messrs. Siemens Brothers, of London, had already pushed their experiments up to 45,000 volts, and had at the Naval Exhibition an apparatus capable of delivering a current of two ampères at this enormous pressure, that is, of dealing with the energy of 120 h. p. For various reasons there have been very few demonstrations of the power of the apparatus, but it is intended that it shall form a prominent feature at the Crystal Palace exhibition, where, doubtless, all who appreciate its importance will endeavor to see it.

It is almost impossible to convey by words any idea of the visible phenomena accompanying the efforts of a 40,000-volt current to bridge on open space, but we will attempt a description of what we saw one evening last week. Upon a table there was fixed an electrode, some three inches in diameter, connected to one terminal of a transformer. Over it there was mounted a large sheet of glass three millimetres thick, and above the glass there was a second electrode terminating in a sharp point, the distance between the electrodes being three centimetres. When the current was turned on to the primary coil of the transformer there first appeared a purple haze at the upper electrode, streaming toward the glass. As the current increased this haze grew in fullness and definition, and began to throw out feelers which darted outward, and as quickly withdrew. As the electromotive force augmented still further these feelers gathered power until they beat themselves on the glass as if they would force themselves through it in their mad desire to reach the other electrode. The whole space below the pointed conductor became alive with them, and exhibited a mass of leaping, crackling threads of purple fire, which writhed and twisted in impotent attempts to burst through the barrier, and failing that, spread themselves along its surface endeavoring to rush over its edges, and so reach their goal by a circuitous route. But this was beyond their strength until the electromotive force approached 45,000 volts, when suddenly the entire appearance was changed. The current overleapt the edges of the plate and flowed completely around it in all directions. At that moment the intense purple color of the spark disappeared, and was replaced by white light of the greatest brilliancy, which surged and scintillated in a way that produced acute fatigue of the eyes in an extraordinarily short time. Although steadier than before, the discharge still kept up its spark-like character, enfolding the glass plates in gleaming coruscations, which glistened and flashed until the spectators were fain to turn away their bedazzled gaze.

A change in the arrangement was then made. The upper pointed electrode was replaced by a brass disc three inches in diameter. This was laid over the surface of the glass plate with three very thin washers of vulcanite intervening between the two. The current was then turned on, in the same gradual manner as before. The space between the two discs immdiately filled with purple light, which had sufficient motion in it to recall the flame of a Bunsen burner, spread out under the bottom of a beaker. Sparks then began to appear at the edges, and, as they gathered strength, to radiate a little beyond them. Gradually they became streamers stretching out along the surface of the plate, in curved fanciful forms which twined and twisted and weaved themselves into a glistening filagree, compared by an imaginative spectator to an agonized Japanese chrysanthemum. This experiment had not the brilliant refulgence of the one that preceded it, but was characterized by a quivering irradiation which wreathed and tossed like a bird beating itself at the bars of its cage. In spite of its less formidable appearance, however, it proved destructive to the glass, which presently flew in pieces with a crash. Several sheets were tried in succession, but each was pierced and broken, and allowed the current to attain its object of flowing directly from one electrode to the other.

The last demonstration showed an arc under pressure of 44,000 volts. When the electrodes approach to within five inches the arc established itself, but instead of the flames bridging the space they streamed out in two thin tongues at right angles to the electrodes and parallel to each other. If the electrodes were pushed nearer together the flames deserted their extremities and wandered back along their stems, evidently repelling each other. The light produced was of course, very small indeed.

In conclusion we may add that the voltage was reached by two transformations. An 80-volt current was first raised to 2,000 volts by one of Siemens' cable transformers, consisting of a long core of wire rope, composed of soft iron wires covered with a layer of specially prepared insulating material, around which are wound two insulated conductors, one forming the primary and the other the secondary circuit of the transformer. The secondary current was then raised to 45,000 volts by a transformer of the usual type.

* From *Engineering*.

A New Street Car Motor.

The Western Electric Company, of Chicago, is supplying street railway companies with an improved form of motor and truck of the Eickenmeyer model, the essential features of which are worthy of careful inspection by all practical street railway men. It embodies the features of both the gearless and reduction gear motors in a combined motor and truck.

Fig. 1 shows the truck complete, as fitted with the new motor, while Fig. 2 gives a very good idea of the various parts and their construction, the motor being removed from the car, its frame inverted, and the armature, coils, etc., shown separately.

A drum form of armature is used, having 74 coils. These are wound on an arbor, from which they are removed and thoroughly dried and insulated and then placed in position so that, should a coil become damaged it may easily be removed and replaced without interfering with the other coils or with their work. The armature is supported midway between the two axles and has its shaft connected by ordinary connecting rods with crank pins to both axles, the connecting rods being attached to both ends of armature shaft, and the cranks set at an angle of 90 degrees, preventing the armature from ever getting on the dead centre and also giving a maximum starting torque in all positions.

A second feature is the use of only a 26-inch car wheel in place of the usual 36-inch wheel required to raise the gearless motor above the roadbed, the smaller wheel allowing a higher armature speed and consequent increase in commercial efficiency. Owing to the form of frame no extra sheathing is required to protect the motor, as it is entirely inclosed in an iron clad casing. The field magnets are built of the best material. The rheostats are placed in boxes supported over the axles, and the controlling mechanism connected by shafts running the entire length of the car may be operated from either end; while all switch mechanism is protected in casing below the car floor within easy access for repair and inspection. The sills of the car body rest on the four iron brackets placed on the motor castings, and on beams that extend across each end of the truck. Captain Ernest P. Warner, of the Western Electric Company, takes special pride in showing this truck and motor to those who are interested in street railway traction apparatus.

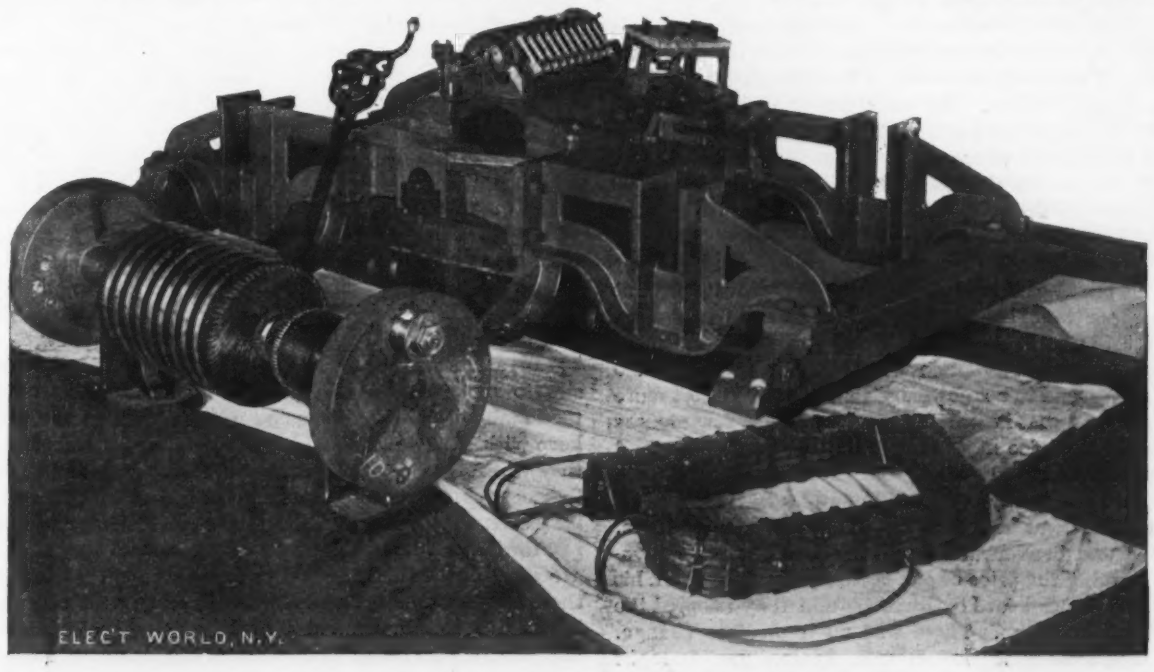


FIG. 2.—A GEARLESS, DIRECT CONNECTED MOTOR.

The Clark Search Light.

This electric arc lamp is made especially for search light purposes. It is attracting a great deal of attention and is of great interest to those interested in navigation of various kinds. It is a most ingeniously arranged affair, being mounted on swivelled trunnions and can instantly be turned to throw light in any direction. Mr. Ernest P. Clark, the inventor of this lamp, recently illustrated its operation to a representative of THE ELECTRICAL WORLD at the American Institute Fair, by revolving it and placing it in every conceivable position. The lamp burned steadily and uniformly during all the various movements, and was evidently not affected by changes in its position. As there are no cords or weights used in the construction of this lamp,

and as its action is entirely independent of the effects of gravity, it will work as perfectly and as freely, it is stated, on a vessel in a heavy sea as on land. It is claimed that these superior advantages are not possessed by any other search light, and that the attention required to operate this lamp is very much less than any other search light. This lamp, which attracts more attention than any other exhibit at the American Institute Fair, is exhibited by the Clark Electric Company, of 192 Broadway, New York, and it is their intention to place on the market the most reliable and durable search light manufactured for every purpose.

How to Get Paying Loads for Stations.*

BY WM. D. MARKS.

When the constructing engineer, who may be called the organ builder, has completed the station he will, if he is fond of his own ease and can afford it, give way to the general manager or engineer, who stands toward him in the relation of the organ grinder. The manager, if he has not had previous experience, soon finds that he must combine with his knowledge as an engineer the energy of the locomotive, the activity of the devil, the sleepless vigilance of Cerberus and the manners of a courtier. In days of prosperity and smooth running his Board of Directors will gladly share with him the credit and glory of success—in fact, very few will hear of him at all; but let anything go wrong, let a breakdown occur, or the enterprise not prove profitable, then there is but one man to blame, and that is the general manager. It is proper to say right here that this opinion is the result of observation and not of personal experience. The writer desires to express his grateful appreciation of the uniform courtesy and assistance he has received from his own Board of Directors, who have patiently waited for two and one-half years for a dividend now fairly in sight for the first time. But this, unfortunately, is not generally the case.

Those of you who are familiar with the history of central stations know how frequently your kindly inquiries after the managers of early days are answered by "He is dead," "He is in the insane asylum," or "I don't know where he is; he couldn't make the station pay and resigned." These few words form the epitaph of many an able manager who has bravely struggled on against overwhelming difficulties and become discouraged, to be succeeded by another, and perhaps another, until the public, becoming acquainted with the light, and sure of its permanency, have taken it in sufficient quantity to pay the running expenses of the station, after which the progress and profits rapidly increase. The fortunate manager who came in at that period of the company's history had but to look sharply after the machinery, give a thoroughly good light and make prompt collections to give great satisfaction to a body of stockholders who had invested their money for the purpose of obtaining dividends, and, as one of ours told me, "are in this business for money."

The question "How are we to reach this happy condition of affairs in the briefest space of time?" is proposed for discussion. First of all, the story of the Philadelphia station is not a mere theory. We have a good paying load of 64,000 "sixteens," and only half the machinery in. The station is designed to carry 80,000 lights burning at once, and we can, when the station is completed, wire 150,000 lights and carry them, basing our estimate on Philadelphia's average burning in the past.

The price of gas is $1.50 per M., which is the same as ¾ of a cent per 16-candle lamp hour. We fixed the price at 1½ cents per lamp hour at the start, and we ran from March 5 to Oct. 1, 1890, with rather poor success in obtaining lighting. The price was the same as gas at $2.25 per M. We had to acknowledge that electricity cost more than gas, and that it was a luxury. After a few months we fixed the price at ¾ of a cent per lamp hour, and directed our agents to say that our light cost just the same as gas, and was vastly better and more healthful.

This change was brought about by Mr. Edison's influence. I had several conversations with him and he always advocated meeting the price of gas squarely. I finally laid his views before our board of directors and they adopted the price named by him. There was an immediate change. The simple statement "it costs no more than gas" brought many consumers to us who had heretofore refused to consider the matter of using electricity. We did no free house wiring, but we at first furnished service, meter and lamps free of charge. We did this until Oct. 15, 1890; after that we furnished only a meter free and the consumers paid for service and the first installation of lamps. We still renew lamps free of charge when not broken. We preferred not to do house wiring or to sell any particular make of motor. We got out elaborate rules and tables for house wiring and established an inspection department and insisted on the rules being obeyed to the letter. We urged upon the gas fixture men of Philadelphia the establishment of wiring departments and we wrote to all motor firms we heard of, asking them to appoint agents in Philadelphia.

This has resulted in the establishment of 13 wiring firms and the appointment of agents for 19 motors of different types. We had thus obtained 32 canvassing agents who made a profit if they secured customers for us but who did not get salaries from the Philadelphia company. We paid 15 cents premium for all lights secured and $1.50 per horse power on all motors when the current was turned on. Each one of our 32 free lance agents had his own circle of acquaintance and lines of influence.

No injustice is done in saying that new things meet with twice the opposition in Philadelphia that they find elsewhere. But this body of canvassers was invincible. If we heard, or thought we heard, of a man who wanted light or power, we sent a card to each of the 32 firms and before night that man surrendered or left town. Very few escaped us. We had tin flags painted red and put on the end of a pointed iron bar, and on these was painted, "The Edison Electric Light Company. Apply for services at 909 Sansom street." At night we guarded our ditches by hanging lanterns on hooks on these flags, and in the day time we left them standing without lanterns. We advertised every ditch and line of conductors this way. We did not advertise steadily in the newspapers, but we distributed throughout our district thousands of circulars, giving all the information that an intending customer could possibly want. We had but one salaried agent as solicitor, and he also received a commission on lamps and motors, and earned, I think, three or four thousand in addition to his salary in one year.

Every form of advertising and solicitation paid, and paid well, *but the best advertisement of all is a satisfied customer.* Give a customer an honest 16 or 17 candles all the time, but no more; charge him the fixed rate and stand by the meter record. The meters have proved uniformly correct; if they err at all, it is against the company, because of overloading. Our meter plates are always weighed in succession by two independent weighers, this work for 1,100 consumers keeping them busy all the time.

All of the staff of employés are instructed to be uniformly polite and reticent, no matter how unreasonable the consumer may be. If a bill is disputed, we test out the wiring for grounds or crosses and go over all of our meter calculations again. If there still appears the slightest ground for just complaint, an inspector is detailed to keep a lamp hour record by actual count. *We have never found our meters to overcharge the consumers.*

If a complaint is made of a motor bill we pursue a similar course and also by means of an ampère meter test the current. We frequently find motors loaded to twice their rated capacity. If we are satisfied that we are correct, we notify the consumer that 15 days after date of the bill his current will be cut off; and this is done and he is sued for the bill. If a consumer does not pay his bill in 15 days, the chances of his doing it at all are very slight, and it's no use talking to him after a bill gets old.

Our general agent visits in person many of our consumers who have by misconception felt themselves aggrieved, and we find that a pleasant discussion and explanation of the matter in dispute almost invariably ends in a clear and cordial understanding with our customer. We try to be unfailingly just with our customers, regardless of consequences to ourselves, and we feel now that they believe in us.

We sell power to all 110-volt motors at lamp rates. For 220-volt motors our rate is 7½ cents per horse power hour. If a consumer takes more than 1,000 horse power hours and less than 1,500 we fix the price at $75 for four weeks. All power above 1,500 is sold at 5 cents per horse power hour.

CONTRACTS VS. METERS.

The question at once arises in the minds of many of my colleagues, Why not sell light or at least power by contract instead of meters? The answer is, Because in the long run it is less profitable, and overloads the station too quickly. The underlying law of all business is selfish, money getting or saving. You will recall how our energetic band of 32 canvassers was secured by taking advantage of their desire to make money. Without being deliberately and intentionally dishonest, nine consumers out of ten will fail to keep within the limitations of a contract for light and power, they will forget to turn out lights and to stop motors unless they are reminded of any oversight of this sort by the regular presentation of meter bills. Making contract consumers pay for lamps does not seem to check them; they simply growl about the short life and price of the lamp, and besides these frequent small charges for lamps serve as a constant irritant to consumers, and provoke much criticism of the lamps. Still the meter alone without any contract has its disadvantages.

When we were furnishing lamps free of charge, a gentleman on Rittenhouse Square put 400 lights into his dwelling and paid us by meter bills $800 the first year, $2 per lamp per year only, and we had furnished free service, free meter and free lamps; certainly not a profitable investment. So we now make all consumers guarantee us six cents per lamp per week and only put in a free meter and cut-out, and renew lamps free. If the lamps are burned on an average more than six cents worth a week, a meter bill is rendered. This insures a minimum earning power for each lamp of $3.13 per year and does not frighten consumers away.

It would appear from our experience as though light consumers were profitable in the following order, although no rigid classification is possible; Restaurants, gambling houses, etc., clubs for social purposes, hotels, newspaper and telegraph offices, theatres and opera houses, small factories and business houses, stores for sale of dry goods, etc., buildings used for offices, dwelling houses, Protestant churches.

The latter being opened only on Sunday and a few evenings in the week and on those days for a few hours only, should never be lit without a contract insuring the earning power of the lamps. The only advantage that can be claimed by churches is that they use light when almost every one else does not do so. At the start we heard a great deal of special inducements to be offered to consumers who used light and power "out of hours," that is, before 5 and after 11 P. M. and on Sundays. With the exception of printing offices and churches, there are very few of these consumers. It is certainly advantageous to get them, but they do not exist in large numbers. Motors which run during the day, say from 7 A. M. to 6 P. M. are advantageous as giving the machinery of the station a uniform load, but in winter when the lighting begins at 4:30 P. M. they overlap the lighting load, making a maximum load occurring between 5 and 6 P. M. and sometimes a very high maximum as compared with the average load. Small factories, business houses, stores and buildings used for offices closing at 6 P. M. all add largely to this maximum load without burning on an average more than 1½ hours in 24, and for this reason should not form too large a proportion of the station load.

We have endeavored in every way to increase the sales of our current, and for this reason we have sold all supplies required by wiremen at eight per cent. advance on their net price as billed to us, thus reducing the cost of wiring. We believe results to have shown this to be a proper policy.

We have endeavored by concentrating all of our machinery into a single station of large capacity to obtain great economy of running expenses, and to enable the employment of the best possible men in each special department. All and every expense of running included, it costs us from $2.50 to $3.00 per lamp per year, and we obtain a revenue of about $5.00 per year from each lamp.

A subject of anxious thought to all managers is how to increase this revenue per lamp. By getting lamps that burn long hours is the answer, or by getting motors for day service. But motors do not pay as high rates for current as lamps and people who use light long hours will put in an isolated plant if they have more than a very few lamps.

I cannot give my own views better than to repeat to you my letter of Feb. 17, 1891, addressed to our Board of Directors, as follows:

PHILADELPHIA, Feb. 17, 1891.

"GENTLEMEN: Touching the matter of the cost and the selling price of electric light and power, it seems to your engineer and manager that with the near approach of the limit of our present machinery and buildin g capacity he should lay before you his views in detail as to the proper method of dealing with our consumers, which, while equitable to all, he hopes will result in increased daily profit to the company.

"At present on an average all of our lights and motors are profitable to us, costing us $\frac{85}{100}$ of a cent and being sold at from ½ to ¾ of a cent per lamp hour. Had we storage capacity for electricity, as has a gas works, we would be able to continue all and increase indefinitely until the full capacity of our feeders, 50,000 lamps burning at once, or say 100,000 lights wired, had been reached; as it is we must stop when we reach 14,000 ampères or about 30,800 16-c. p. lamps burning at once. This would appear to be the case when we have 67,500 lamps wired.

"While all of our lamps are profitable to us as stated above, still there being a limit to the number attached there must be a sufficient margin of profit on the average to enable us to meet the demands for dividends, interest on and sinking fund for debenture bonds. We can neglect our floating indebtedness, as I am advised that there are enough quick assets to cover this.

"Thus we have to meet the following demands the first year:

Sinking fund to retire debentures	$37,500
5 per cent. premium on the same	1,875
Interest $300,000 at 6 per cent	18,000
Dividend, 6 per cent. on $1,000,000 stock	60,000
	$117,375
Amount cash surplus required each month	$9,781.25
Cash surplus for January	12,766.69

"Thus you will see that this company is already on a dividend earning basis.

"As the sale of merchandise and isolated plants forms but a small part of the duties of those employés having the care of it and will not increase, we can neglect it as not forming a separate and important item.

"We have 55,064 16-c. p. lamps connected, and our gross income is $28,507.09, yielding us $51\frac{4}{10}$ cents per lamp per month, or $1\frac{71}{100}$ cents per lamp per day, the average burning of each lamp being $2\frac{56}{100}$ hours. This gives us an average selling price of $\frac{668}{1000}$ cent per lamp hour. Then for each 16-c. p. lamp we have:

Average income	1.71	cents per day
" cost 2.56 hours at .346c	.89	" " "
" profit per lamp	0.82	" " "

"Thus we see that we have reached a moderate dividend earning basis with an average profit of .82 cent per lamp per day, but the risk of the business and the long delay in obtaining any return for capital invested should make us give careful thought to any scheme which promises to enable us to obtain larger dividends.

"Each director has had offered to him an elaborate analysis of the record of each consumer, and those who are interested can judge for themselves of their value.

"Assuming now that it is decided not to continue lights yielding less than .82 of a cent profit per day and thereby to raise the average above the present, we can construct

*A paper read at the recent convention of the Association of Edison Illuminating Companies held in New York City.

the following table of prices yielding the same profit each day:

Selling at per lamp hour.	Profit per hour.	Hours burning required.	Discount from ¾ cent.	Remarks.
.40	.05	16 to 24	47 per cent.	The hours are given only with sufficient approximation for business purposes.
.45	.10	8 to 16	40 "	
.50	.15	5 to 8	33⅓ "	
.55	.20	4 to 5	27 "	
.60	.25	3 to 4	20 "	
.65	.30	2⅔ to 3	13 "	
.70	.35	2⅓ to 2⅔	6 "	
.75	.40	2 to 2⅓	Premium on ¾ cent.	
.80	.45	1¾ to 2	7 per cent.	
.85	.50	1.64 to 1¾	13 "	
.90	.55	1½ to 1.64	20 "	
.95	.60	1.36 to 1½	27 "	
1.00	.65	1¼ to 1.36	33⅓ "	

"The cost of lamps is about one-seventh the running expense of the station, and, therefore, the cost of a horse power hour is 4½ cents. You are aware that we sell at 7½ cents, save in cases where a consumer uses more than 1,000 h. p. hours in four weeks, in which case he gets his power at five cents per horse power hour for the same reason and upon the principles which I have set forth in the case of lamps.

"Careful consideration of the table will convince you that there are cases of burning long hours in which apparently great concessions in price will result profitably to this company, and on the other hand that there are consumers burning short hours who should be charged a higher price than three-quarters of a cent or not be taken at all. For instance, the Bullitt building should be charged one cent per lamp hour to bring it to the average. The Aldine Hotel averaged a return of .55 cent the first year, but this year has been using the light extravagantly. Its contract should be terminated next September, and no contracts taken based on the former gas bills in any instance. Besides the greater profit of long hours, there are many advantages to the machinery, apparent only to the engineer, which he will not state here.

"Since the special order of this board of something more than a year ago directing your engineer and manager to make all contracts for light and power he has been guided by the principles set forth above, but now feeling that perhaps you would prefer to have others undertake this work he is impelled by his interest in the welfare of this company to enunciate them in writing and to beg your careful consideration of them before taking such action as might diminish the profits of this company."

It is proper to add that we have not a dozen cases in our 1,100 consumers in which any concession is made, and that we are actively engaged in getting rid of them as full rate consumers offer themselves. We have had elaborate analysis of the value of each consumer made, and know exactly what he is worth to us.

It does not properly come within our province in this paper to discuss economy of production, but I will state what are the principles upon which the erection of the Philadelphia station was based, viz.: Concentration of power, economy of running expenses, simplicity of design, certainty and regularity of action of machinery.

We use Armington & Sims single cylinder engines, making 220 revolutions and developing 440 h. p. at 150 pounds steam, one-quarter cut-off. They have performed very satisfactorily, doing all that was promised for them.

Our dynamos are No. 60 Edison type, making 400 revolutions and developing 1,000 ampères each. They have performed to our entire satisfaction, giving us great comfort since replacing iron bearings by phosphor bronze. They will pull a station through almost any short circuit that occur.

Our underground system remains practically perfect wherever we have used the Kruesi tube or the Edison system. Cables, whether lead covered or not, have given us great trouble and expense where we have been forced by the city authorities to pull them into wooden conduits. It is far better to bury a cable in the ground than to put it into a street conduit which is not hermetically sealed. Our services are 3-wire lead covered cables buried in the ground, and of the many hundreds now in I cannot recall a single instance of trouble from them.

To recapitulate in brief, I would say: Put the price of light and power as low as you can, and thereby secure the permanency of your business as against competition. Do no free house wiring, but get others to do your wiring and make it profitable to them by offering premiums if necessary. Put no free lamps in first installation, but renew them free of charge. Own your own meter and service; it is not good policy to let the consumer own the service. Do not try to sell any particular make of motor, and be careful not to express any preference. Offer premiums to agents. Sell current by meter, but have a minimum contract price, to insure earning power of lamps and motors. Above all things always give a good light, but not an excessive amount of it. Do not talk with or write in a threatening way to consumers who do not pay promptly: stand by the meter and cut off the light. Be open and courteous in acknowledgment of errors, and repair any injury unwittingly inflicted, regardless of consequences to yourself or the company. Don't believe the statements of consumers until fully verified.

At the end of the second year from the start we find our Philadelphia company on a solid dividend paying basis. In any other enterprise of equal magnitude this would be called a great success.

The Elements of Practical Electricity.*

BY DR. LOUIS BELL.

THE EFFECT OF THE EARTH'S MAGNETISM ON A SUSPENDED MAGNET.

In using the deflections of a suspended magnet to measure magnetic force of any kind, whether produced by other magnets or what is really the same thing, the effect of a solenoid or coils of wire, our first object is, as I have before mentioned, to find out how much the deflection varies with the magnetic force that produces it. And since the opposing force—that tending to keep the needle in its original position—is the earth's magnetism, if we can find out how the magnetic pull of the earth on a suspended magnet changes with reference to the deflection produced, we shall be able readily to solve our problem; since, whatever the deflection of the suspended needle may be when it comes to rest, the earth's magnetic pull corresponding to that particular deflection must be just equal to the opposing push or pull of the magnetic force we are trying to measure. In other words we shall be able to compare the strength of the earth's magnetism at a given point with that produced by any magnet or electric current. We thus have at our command a very convenient method of comparing by their magnetic effects the strength of two magnets or the strength of two currents. In any given locality the magnetic force exercised by the earth is quite uniform and constant, tending to hold the suspended magnet north and south—the pull at all events is in a north and south direction. When as in Fig. 22 the magnetic needle is in some other direction than north and south, it experiences a pull tending to rotate it back into position. You can very readily see that if it stood west and east a pull exercised in a north and south direction would have a greater effect than if the needle were originally nearly north and south, for in the first case almost the whole effect would be the rotation of the needle, whereas in the other case the pull, being at anything but right angles with the needle, will not have so much effective strength. You must also notice that there is an equal effect on the two ends of the needle, its north pole tending to swing around toward the north and south direction, and its south pole having the same tendency; we may think of it, in fact, as subjected to two

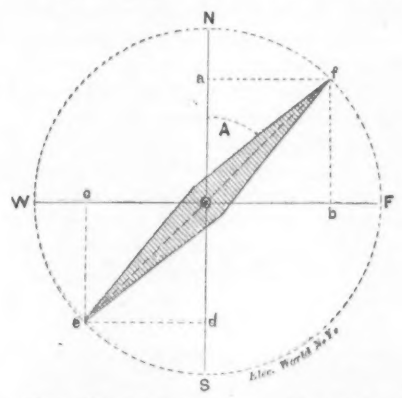


FIG. 22.—THE DEFLECTION OF A MAGNETIC NEEDLE.

equal and opposite pulls, acting at equal distances from the point of suspension of the magnet and tending to twist it around. Two forces acting in this way on any rigid body tend simply to turn it, and form what is known in mechanics as a "couple." The effective power of any couple—what is known in mathematics as its moment—is equal to the product of either one of the forces by the perpendicular distance between their directions. In Fig. 22, then, the effective power of the couple is the force pulling in the direction $b\ f$, multiplied by the length $c\ b$.

The reason for this value is easy to understand through the familiar fact that a given push on a long lever arm is more effective than an equal push on a short lever in the exact proportion of the difference of lengths. Now, so long as either pole of the needle $e\ O\ f$ is pulled around toward the north and south line in the direction $b\ f$, this pull—and we have seen that the earth's force is nearly constant—is effective just in proportion to the lever arm $b\ O$.

In other words, the pull along $f\ b$ or a line parallel to it being equal at all times, it is effective just in proportion to the lever arm $O\ b$ through which it acts, and since the pull at each end of the needle is equal, and the lever arms are equal, we can get the moment of the couple tending to restore the needle to its north and south position by multiplying either pull into $c\ b$ double the lever arm of either. Now, simply for convenience, let us abbreviate the moment, in other words the turning force wherever the needle may be, by calling it M. This is simply a matter of convenience to save writing out the word every time. Now let us see on what the force exercised by the earth on the magnet depends; we can find out by experiments that it depends on two things, first, the strength of the earth as a magnet, and second, the magnetism of the suspended needle. A strongly magnetized needle will come around into a north and south position much more quickly than one weakly magnetized. As a matter of fact the pull depends on both these and is equal to their product; in other words, it equals the strength of the magnet multiplied by the strength of the earth's magnetism at that particular place, or abbreviating just as we did with the moment and calling the strength of the needle's magnetic force m, and that of the earth H, the letter by which it is almost always designated, we shall find that the force acting in the direction $f\ b$ is $m \times H$. So much for the force. The lever arm is $c\ b$, but this distance $c\ b$ can be very readily expressed in terms not of inches or feet, but what is more convenient, in terms of the length of the magnet, which is constant, and the angle through which it is deflected. Looking at Fig. 22 you will see that $O\ b$, being the same as $a\ f$, is the sine of the angle $a\ O\ f$ through which the needle is deflected, and is equal to the half length of the magnet multiplied by the "natural" sine of the angle A as found in the table given last week. By "natural" sine we simply mean the length of the sine when the radius is 1.

We thus find that the effective power available for turning the magnet around, whatever its position, is equal to the magnetic force exercised by the magnet pole, multiplied by that exercised by the earth, multiplied by the length of the magnet and by the sine of the angle through which it is deflected; or writing it down in our simple notation by letters, $M = m\ H\ l$ sine A. Suppose that this angle of deflection A is produced by a magnetic force from a solenoid acting at right angles to the earth's force—let us call this new force F for short—and suppose its tendency is to pull the needle into an east and west line. Turn Fig. 21 around 90° and you will see that you can figure out the moment or turning power of the new couple produced by the current just as we have already done, except instead of H, the earth's force, we shall have F, the force we want to measure, and instead of $b\ O$, the sine of the angle A, we shall have $f\ b$, its cosine. If between the action of the two magnetic forces the needle takes a steady deflection, the two couples must evidently be equal, else the needle would turn; so, since things which are equal to the same things are equal to each other, we can write out in abbreviated form the relation between the two thus—$m\ F\ l$ cosine A equals $m\ H\ l$ sine A; m and l are common factors, so if we wish to find the ratio between F and H, we may drop m and l out of the computation. We then have left a very simple proportion between F and H—in fact, F is to H as the sine of A is to the cosine of A, but the ratio between these last two is, as we have already seen, the tangent of the angle A, so that finally we find that in terms of H F the magnetic force we want to measure equals H multiplied by the tangent of the angle A; or, putting it into words, the magnetic force which, acting east and west, produces the deflection A on a magnetic needle, is equal to the earth's magnetic force at that place multiplied by the tangent of the angle A. Of course only that part of the earth's magnetism is effective in turning around the needle which acts horizontally upon it, since any tendency to pull either pole of the needle up or down will not affect its swinging around.

If we know the value of the earth's force horizontal H, in any convenient units, we can very readily measure any magnetic force; even if we do not know how big H is we can compare two magnetic forces very readily, for they will deflect the needle through angles the tangents of which are proportional to the forces themselves. Thus, without knowing the real value of the earth's magnetic force, we can compare the action produced on the magnetic needle by two currents very easily, provided the two currents are used in precisely the same way with respect to the needle; in other words, when they flow through the same fixed wire.

Our next effort then will be to construct an arrangement consisting of a fixed coil of wire and a magnetic needle suspended in a fixed relation to it, so that we may be able to compare accurately the strengths of two electric currents. Such a piece of apparatus is known as a galvanometer.

(To be continued.)

* Continued from THE ELECTRICAL WORLD of Nov. 14, 1891.

A Screw Loose.

BY E. G. CONNETTE.

The truth of the maxim, "There is a screw loose somewhere," was recently experienced at the power plant of the United Electric Railway Company, of Nashville, Tenn., and that experience may serve to keep others out of a similar trouble in locating the cause and removing the difficulty. The No. 7 generator of the plant one day during the past week began to show a "tired feeling," and after two or three days it had become so tired that it would not do the same amount of work as the other machines, especially when a heavy load would come on, indicating that the compound coils were short circuited, burned out or not working. The machine was thoroughly tested and every part of it tested out correctly. The connections were examined and all the instruments on the switchboard, and they were found intact. The situation was somewhat puzzling and there was but one thing left to do; to try the lightning arrester, which was "cut out" and everything worked perfectly. The arrester, which is of the Thomson-Houston pattern, was then taken apart, and it was found that the screw which fastened the copper magnet strip to the core of the magnet had become loose and produced an arc between the screw head and the copper strip, burning sufficiently to prevent a perfect contact, and partially if not altogether cutting out the compound coils. This being remedied, the generator did its work perfectly. It is doubtful if a similar case has ever been heard of, and as it might happen again, the experience as stated above may be of benefit to others.

New Edison Projector.

Mention was made in the article on the new Madison Square Garden in the last issue of THE ELECTRICAL WORLD the search light used on the tower. A more detailed description of it is worthy of attention, it being especially designed for this purpose by the Edison General Electric Company.

The mirror is 24 inches in diameter. The carbons are set at an angle of 20 degrees from the perpendicular, and are fed by a right and left hand screw. These are actuated by a differentially wound motor, and the whole is controlled by a small relay that starts, stops or reverses the motors according to the difference of potential in the arc.

A special feature of this lamp is that the mechanism can be detached in a few minutes and entirely removed from the lamp. If anything disables the mechanism it is possible to operate the lamp by hand. It does not matter whether the carbons are actually together or an inch apart, the motor will operate until an arc is established in either case. The movement of the carbons is effected very slowly, so that no flicker or jumping is experienced from sudden movements of the mechanism.

The lamp is designed for a glass mirror on the Mangin principle, which is far more perfect than any system of paraholas. At present a temporary parabolic mirror made of silver plated copper is used, which makes the reflector appear at a disadvantage.

The carbons being set at an angle and the negative in advance of the positive, about 80 per cent. of the light is sent in one direction, *i. e.*, to the mirror, and of these a cone of light of 95 degrees is utilized. Standing behind the lamp properly inclined and adjusted nothing can be seen of the crater in the positive carbon, but a shield is provided to cut off the rays from the incandescent points.

In the projector now used (of which drawings are here shown) the carbons are protected in a cone of refractory material partly to concentrate the heat and partly to obviate draughts of air. The mirror is also arranged so that it can be adjusted to the carbons instead of adjusting the carbons to the reflector as by older methods.

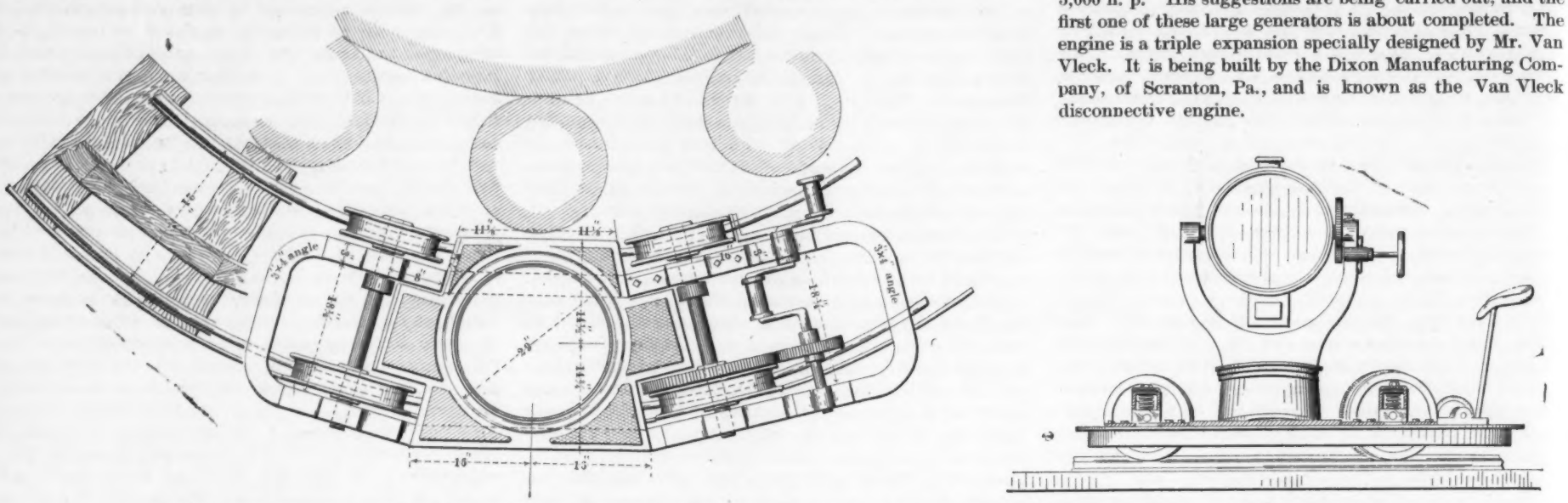
No trouble has been experienced when running currents of 100 ampères or more, which is usually the case without this device, while, in addition, it considerably intensifies the light.

Arrangements for observing the arc are very complete. Instead of a blue-tinted glass, through which the operator can see the arc more or less imperfectly and with imminent risk to his eyes, an optical arrangement is used in which a lens throws a distinct image of the arc on a ground glass. This ground glass is furnished with cross lines so that the centring of the arc can always be effected by the hand wheel shown on top.

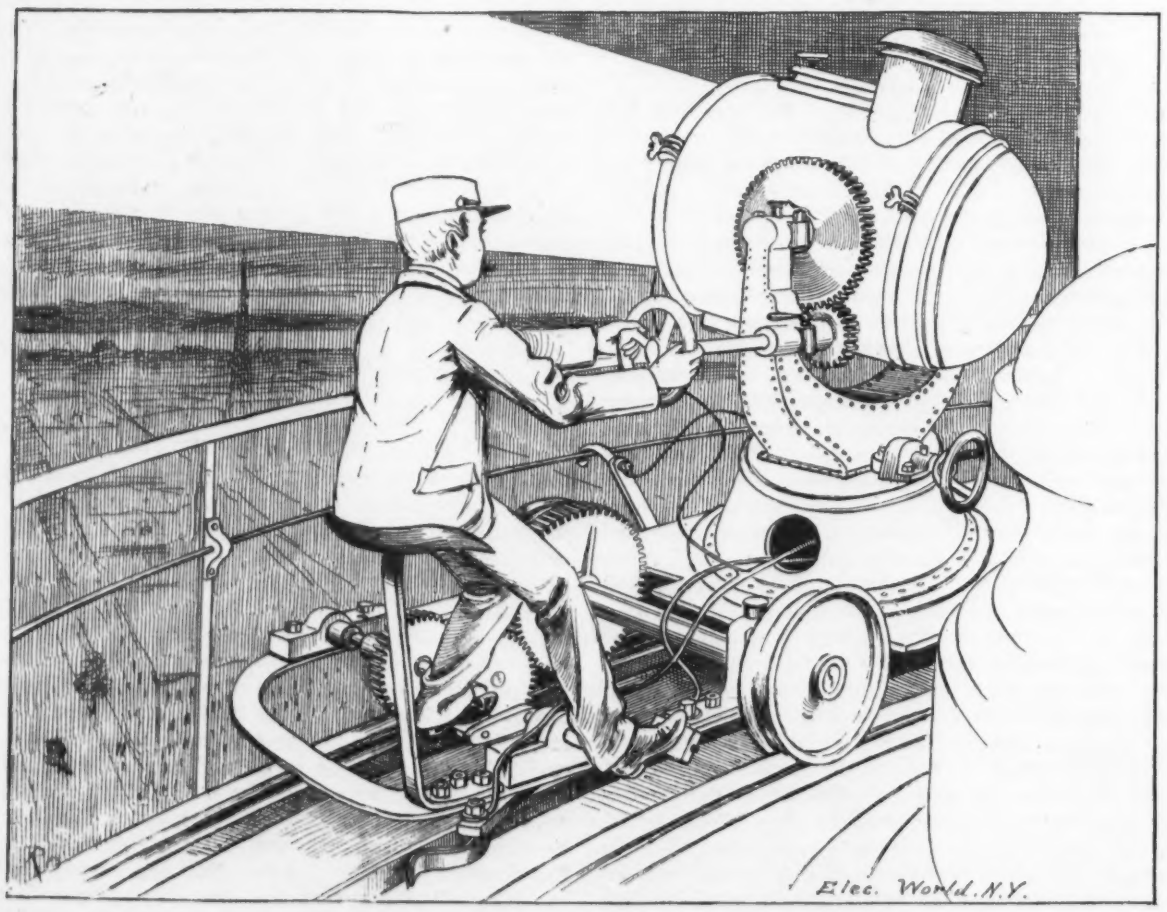
The performance of the lamp, under good conditions, on a dark night, free from mist and haze, is to distinctly show up a light colored object at 5,000 yards. For an automatic device, it is the largest permanent reflector ever installed in this country. Up to the present, owing to the optician's delay in sending the mirror, and the failure to obtain the proper carbons, the lamp has been working to a disadvantage; but it has, notwithstanding this, created no little comment in the New York papers, and serves the purpose for which it was designed.

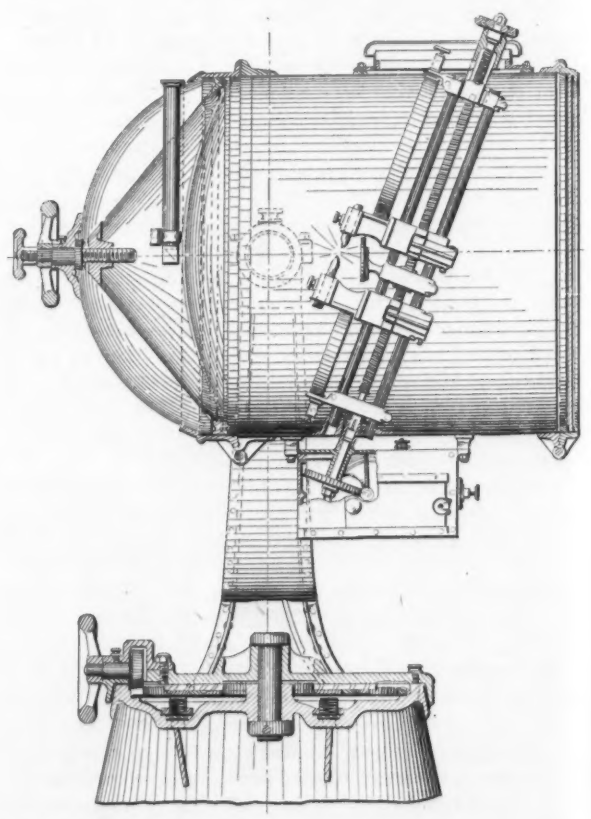
This reflector operates on a circular track around the tower at a height of 340 feet. It is mounted on a carriage designed by Mr. J. Van Vleck, of the New York Edison Company, a good idea of which can be obtained from the artist's sketch. The operator works a bicycle arrangement that propels the car. Current for the lamp is taken from a centre rail by a brush bearing against it, returning through the wheels to the track. The current to operate the motor is taken from a side trolley, the rails being again used as a common return. A special feeder to supply the necessary current is run from the switchboard in the basement of the amphitheatre.

The projector itself was designed by Mr. Robert S. Dobbie, of the Edison General Electric Company, who promises surprising results in light effects when the outfit is complete.



PLAN AND FRONT ELEVATION OF THE EDISON PROJECTOR AND CAR ON THE MADISON SQUARE GARDEN TOWER.





GENERAL VIEW AND SECTIONAL ELEVATION OF THE EDISON PROJECTOR.

New Type of Central Station.

The new station of the Edison Electric Illuminating Company, of New York, now in course of construction on Elm street, New York City, will embody many new features in central lighting station practice. Current is already being supplied from this sub-station.. Eight large Edison dynamos, driven by temporary engines, are supplying current to the underground mains in the dry goods district.

The entire scheme has been worked out by Mr. J. Van Vleck, one of the brightest young engineers in the business. His recent trip to Europe, and thorough study of practice over there, resulted in his recommending to his company the adoption of large generators of from 1,000 to 5,000 h. p. His suggestions are being carried out, and the first one of these large generators is about completed. The engine is a triple expansion specially designed by Mr. Van Vleck. It is being built by the Dixon Manufacturing Company, of Scranton, Pa., and is known as the Van Vleck disconnective engine.

It is the intention to use very high steam pressure and new quadruple expansion engines. These, together with the "hot blast" system, an elaborate system of economizers and many other refinements, will give an economy never before attained in engineering practice. Many other things are promised, among which will be the Van Vleck system of "cannon piping." This consists of copper pipe wound with steel wire, and fittings made of gun metal. This elaborate system has been found necessary for confining the pressure, which may ultimately be raised to 300 pounds.

Mr. Van Vleck is confident that by the arrangements contemplated he will be able to obtain one horse power from each pound of coal, which will certainly be a great innovation.

Among the electrical features will be large voltmeters built on the Sir William Thomson balance principle. They will have dials three feet in diameter so that the pressure of the system can be read all over the station. The main ampère meters are to be direct-reading instruments, and designed to measure 300,000 ampères. These, like the voltmeters, will be on the Sir William Thomson balance principle.

When completed the station will be 160 feet high, and occupy a plot of ground 200 by 100. Situated as it is, in the heart of a great lighting district, and planned so as to enable the company to sell light at a greatly reduced figure one cannot help believing that this station, when completed

will embody the ideal conditions so often predicted for the electric light, namely, that it will be the light of the world, enjoyed by the poor as well as the rich, and carrying the blessing of health and comfort into the squalid corners of the great city where want and misery seem to have taken permanent lodgings.

Accumulators at the Frankfort Electrical Exhibition.

BY CARL HERING.

In addition to what has already been said in these columns* about accumulators at the exhibition, the following may be of interest:

Curves giving the difference of potential of an accumulator at various stages of discharge and charge have been given very frequently and are well known to those specially interested in the subject; but curves showing the change of capacity at different rates of discharge are not so well known, and for this reason those in Fig. 1 may be of interest. In this figure the vertical distances for the upper curves represent ampère hours and for the lower ones ampères, while the horizontal distances in both cases represent hours. The curve *a b* shows the actual capacity as obtained from measurements of a pair of plates after they had been in use some time. The curve *c d* represents that which is guaranteed by the company. The curve *e f* shows the currents corresponding to the curve *a b*, while *g h* represents those corresponding to *c d*.

It will be seen that the curve *a b* increases very rapidly, especially at first, showing how very much the capacity varies with the rate of discharge; if the capacity were independent of the rate of discharge this curve would of course be a horizontal line and, therefore, the nearer this curve comes to a horizontal line the better will be the accumulator for rapid discharges. It will be seen from this curve that at a 10-hour rate the current is 4.2 ampères and the capacity 42 ampère hours. At double the rate of discharge, that is to say, a discharge in half the time, the curve shows the current to have been 6.5 ampères and the capacity 32.5 ampère hours, which is 23 per cent. (or about a quarter) less than the other. At a three-hour rate, which is exceptionally rapid for accumulators, the current is only about eight ampères, which is only about double that at a 10-hour discharge; the capacity is 24 ampère hours, or 43 per cent. less than that of a 10-hour discharge. It will be seen from the latter that in a discharge of one-third of the usual 10-hour rate the capacity is reduced to nearly half, while the current is only about twice as great. These curves, of course, will be different for different makes of accumulators. The thinner the layer of active material, the more nearly horizontal the curve will become. The curves shown here are those exhibited by the Cologne Accumulator Works, whose accumulators are known as the "Hagen," and were described in these columns some weeks ago.

In order to give a general idea of the rates of discharge, prices, etc., of the accumulators at this exhibition, we prepared the accompanying table, in which the data

TABLE I.

	Capacity in ampère hours.	Capacity in ampère hours per pound of plate.	Capacity in ampère hours per pound of cell complete.	Rate of discharge in ampères per pound of plates.	Rate of discharge in ampères per pound of cell (without acid).	Rapidity of discharge in hours.	List price in cents per ampère hour capacity.	Nature of cells.
De Khotinsky	100					3.5	7 3	
"	100					8.0	6.8	
Hagen	100	1.7	1.1	.57	.36	3.0	10.6	
"	107	2.3	1.4	.44	.28	5.0	8.4	
"	108	2.9	1.9	.29	.19	0.0	6.8	
*Accumulator Company (American)	110	3.7	2.2	1.0	.60	3.7	11.0	
Tudor	111	1.6*	1.3	.32†	.25	5.0	9.8	Glass.
Oerlikon (Schoop)	115	2.9	2.3	.50	.40	5.3		Glass.
Julien (American)	120	6.7	5.2	.72	.57	9.2	6.9	Glass.
Hagen	128	2.7	1.7	.39	.24	7.0	7.9	
De Khotinsky	500					8.0	5.1	
De Khotinsky	500					3.5	5.3	
Oerlikon (Schoop)	500	2.8	2.4	.52	.45	5 4		Glass.
Tudor	505		1.2		.28	3.3	8.7	Wood.
Hagen	504	3.3	2.3	.33	.23	10.	5.1	
"	512	2.9	2.1	.42	.30	7.0	5.8	
"	507	2.8	1. 8	.49	.36	5.0	6.8	
"	520	1.9	1.4	.62	.22	13.0	8.8	
"	1,440	3.4	2.7	.34	.27	0.	4.8	
De Khotinsky	1,600					8.0	4 6	
"	1,600					3.5	4.4	
Tudor	2,100		1.6		.24	6.7	6.3	Wood.

*"Owing to the fact that the figures given by the Accumulator Company do not agree with each other, we have taken them as they are on the printed slip and have assumed that the weight given means complete without acid."

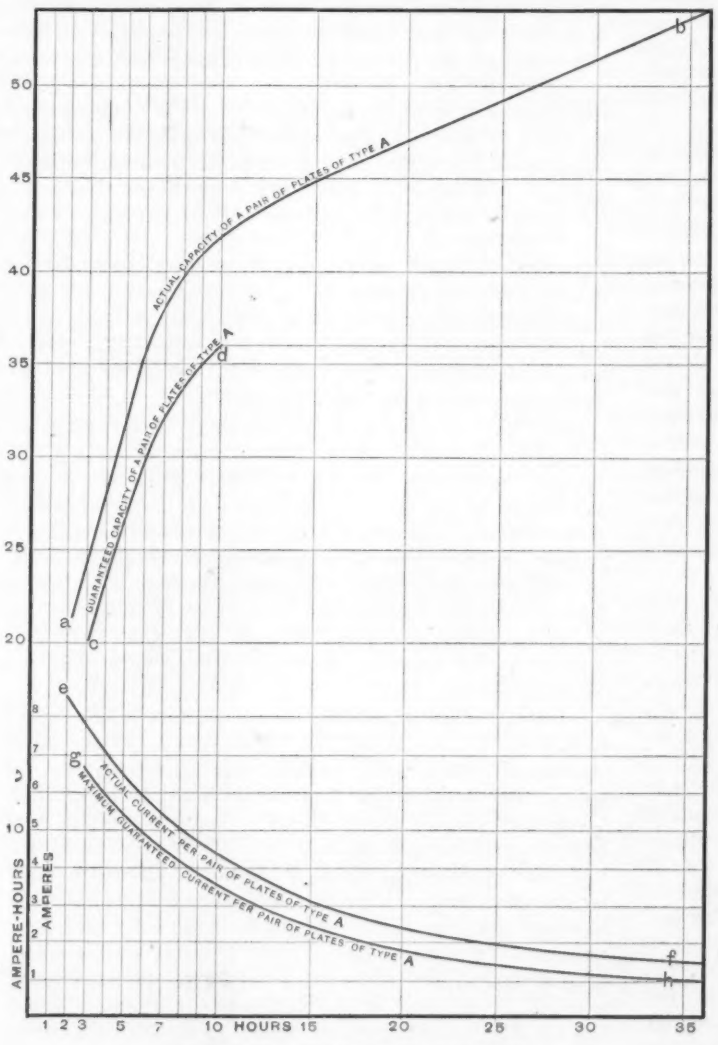
† For an assumed weight of retaining cell.

published for the various accumulators has been reduced to common figures. In the first column of table 1 are given the capacities as published in the respective catalogues. It may not be quite fair to compare the capacities in this way, because some of the makers may tell the truth and others may be too generous, but they are the best figures which could be obtained, and allowances must be made in interpreting them. In this column the accumulators are divided into three sets of about 100, 500 and 1,500 ampère hours capacity, and those values were selected which corresponded most nearly to these three numbers.

In the second column will be found the capacity per pound of plates, and it will be seen from this column that three ampère hours per pound of plates is above the average of those at the exhibition. As some of the makers did not give the weight of the plates alone, we compiled a third column also, in order to be able to make comparisons. It will be seen from this column that the Tudor accumulator, which is practically a Planté cell, is one of the heaviest—that is, having the least ampère hours per pound, but it is, notwithstanding, not much heavier than the "Hagen" type.

The next column gives the discharge in ampères per pound of plates, which, it will be seen, varies between about one-third of an ampère and one ampère, and is very high for the Julien cell, which is due chiefly to the high capacity per pound of these cells, as shown in the second column. The fifth column corresponds to the fourth, but is reduced to ampères per pound of cell, because some of the makers did not state the weight of their plates. Here again it will be seen that the figures for the Tudor accumulator are low, but compare very favorably with those of Hagen. Those of the Julien are again high and those of the Oerlikon Company are also very high, notwithstanding the fact that they have a solid electrolyte.

These four columns, in which the figures depend on the weight of the cell, are of interest only when the weight of the cell is an important feature, as, for instance, for traction purposes, or for portable cells, but for stationary cells, such as those used for lighting buildings and at central stations, the weight of the cells is of absolutely no importance; in fact it may almost be said that the heavier the cell is, the less likely it will be to go to pieces, provided the material is placed where it is most needed. Great capacity



STORAGE BATTERY CURVES.

per pound is, therefore, a feature of little importance for stationary work.

The sixth column gives the rapidity of the discharge in hours. It will be seen from this that a discharge in three to three and a half hours, which used to be considered abnormally rapid, is now quite common in Germany. With such heavy discharges, the capacity is, of course, diminished, as we saw in the curves above referred to, but the capacities given in the first column are those which correspond to the discharges given in the sixth column.

The next column is perhaps the most interesting to the purchaser of an accumulator. In this column we have reduced the cost to cents per ampère hour, in order that the figures may be compared with each other. The list prices were taken, because they were the only ones which could be obtained, and some allowances must therefore be made in interpreting the figures. As a rule the prices are naturally higher for smaller capacities, but as a general average seven cents per ampère hour may be taken (excluding that of the Accumulator company, which is exceptionally high) for about 100 ampère hours; for about 500 ampère hours the average price is about six cents, while for 1,500 it reaches as low as 4½ cents. In order to compare our American accumulators with those at the exhibition, we have added here the figures of two of our principal companies.

In this connection it may be of interest to compare these figures with those of a similar table compiled for the accumulators at the Paris Exposition of 1889.* As a matter of interest we have added here the figures for the original

TABLE II.

	Capacity in ampère hours.	Capacity in ampère hours per pound of plates.	Rate of discharge in ampères per pound of platee.	Rapidity of discharge in hours	List price in cents per ampère hour capacity.	Nature of cell.
Original Planté cell of 1860	17.15	7.25				
Huber	90.	6.8	1 0	6.9	5.9	Glass.
Gadot	93.5	4 5	.87	5 2	6.6	
Faure-Sellon-Volkmar	100.	7.5	.91	5.0	7.7	Ebonite.
Pollak	100.	3.2	.63	5.0	8.7	Wood.
Garassino	100.	6.	.90	6.7	5.8	
Schoop (Oerlikon)	115.	2.7	.48	5.8	6.5	Glass.
E. P. S.	120.			3.0	9.3	Wood.
Elwell & Cie (copper-zinc)	200.	39.	4.9	8.0	3 1	
" " reduced to 2-volt cells	200.	13.		8.0	9.3	
Cély (Sarcia)	250.	4.5	.45	10.0	6.8	
Faure-Sellon-Volkmar	400.	4.6	.69	6.7	4 3	Composition.
Pollak	400.	3.2	.63	5.0	5.3	
Garassino	400.	6.1	.91	6.7	3.9	
Gadot	475.	3.2	.67	4.8	5.9	
E. P. S.	500.			11.0	4.35	Glass.
Cély (Sarcia)	500.	4.5	.45	10.0	5.8	
Schoop (Oerlikon)	500.	2.5	.45	5.4	4.8	Glass.
Huber	565.	7.1	.69	10.0	4.3	Glass.
Faure-Sellon-Volkmar	2,000.	4.5	.68	6.7	3 9	Composition.
Cély (Sarcia)	2,000.	4.5	.45	10.0	4.3	
Elwell & Cie (copper-zinc)	2,100.	41.0	6.2	7.0	2.0	
" " reduced to 2-volt cells	2,100.	13.7		7.0	6.0	

Planté cell of 1860 which was exhibited at this exhibition and it will be seen, strange to say, that the capacity per pound is higher than any of the others, of either the Faure or Planté types. It is likely, however, that this figure, viz., 7.25, represents a discharge which was carried considerably farther than is usual in practice, and that therefore it is not quite fair to compare it directly with the others; but even if it were corrected it would probably still remain among the highest.

The accumulators in this table were either of the Planté or the Faure type, except the one exhibited by Elwell & Co., which is a copper-zinc accumulator, otherwise known as the Lalande and Chaperon alkaline, or in this country as the Waddell-Entz. It has an electromotive force only about one-third that of the lead accumulators, and the figures for it have therefore been reduced, as shown, to two-volt cells. Even then their capacity per pound appears very great, but it is a question whether the published data were as reliable as those of the other companies.

Accumulator Cars at the Hague.

Six accumulator cars, says the *Electrical Engineer*, of London, are now running from the Hague to the Casino at Schevening, a distance of about three miles. The speed of running is 12 miles an hour, including stops. The loaded car weighs 16 tons; it is 32 feet long, carries 68 passengers, and the battery of accumulators weighs 4 tons. The cars, constructed at Harlem, have two bogies of two axles each. Only one bogie is driven, having its wheels coupled together. The axles are connected to the motor by solid gearing, and the whole weight is carried by the axles. The motor is supplied by carbon brushes from a battery of 192 Julien accumulators, weighing 40 pounds each. This battery, when charged, provides current for a run of 45 miles, after which the cars return for change of cells. The accumulators are arranged in eight boxes or drawers, weighing half a ton each, placed under the seats. The car is provided with switches and resistances to allow the speed to be varied. The changing of the sets of cells is carried out by the aid of a special mechanical arrangement to allow rapid handling. Two sets of turntables and rolling carriers are placed at the end of a charging bench. The drawers, when taken from the car, slide easily on rollers placed on the bench and turntables, the operation of changing requiring five minutes. The spare sets of cells are always being charged as the others are being used. The connections are made with spring contacts arranged so that no mistake can occur. The charging is accomplished by means of Silvertown shunt dynamos, with hand regulators, giving 60 ampères at 100 volts. The machine room contains two condensing steam engines of 210 indicated h. p. each. The condensing water is supplied by a siphon from the canal three-quarters of a mile away. The installation is completed by a small workshop driven by an electric motor, itself supplied by a small battery of 70 cells of 66 pounds each, which are also used for lighting by means of 10 arc lamps. It is intended to settle the question of maintenance by the erection of a small manufactory of battery plates on the spot, with a laboratory.

*See THE ELECTRICAL WORLD, Oct. 3, 1891.

*Taken from Hering's report to the United States Commissioner of the Paris Exposition of 1889.

Discussion of Mr. Kennelly's Paper on "Magnetic Reluctance."

The sixtieth meeting of the American Institute of Electrical Engineers was held Oct. 27, at No. 12 West Thirty-first street. The meeting was called to order by Vice-President Thomas D. Lockwood. Mr. A. E. Kennelly read his paper on "Magnetic Reluctance"* which provoked the following discussion:

Mr. Carl Hering: It is a great satisfaction to see from this interesting paper that there is after all a straight line law in magnetic phenomena and that it is so for just that range of values which is used most in practice.

I think it would have been clearer to many readers if Mr. Kennelly had added that the reluctivity ρ, which he uses, is the reciprocal μ. This is inferred in the paper, but as we are usually more familiar with μ than with ρ, I think it would have been clearer, to some of us at least, if that had been stated.

In referring to his curve, Fig. 4, he says: "The reluctivity of iron appears from these curves to commence at a certain definite and moderately large value." It seems to me it is a very indefinite value, because according to the other curves it is the reciprocal of zero. That is to-say, theoretically, this curve would start at infinity, and therefore it follows that the practical initial value would be a rather indefinite value. I am not sure whether I am right in that, if I am wrong I hope Mr. Kennelly will correct me. It certainly does not seem to be a very definite value, because the curve (Fig. 4) is the reciprocal of the curve shown in Fig. 2, which appears to start from or near zero. If this initial value is a definite one why is it not given in any of the Figs. 5, 6, 7 and 8?

Fig. 3 is not quite correct at the end of the curve, and is a little misleading on that account. The curve comes down as if it was going to cut the X line just beyond the figure; but that is not the case as there is a point of inflection there, shown by the two last plotted values. If it were to cut that line it would have values here of a negative conductivity or a source of magnetism, which, of course, is absurd. If the value had been carried out farther the line would tend to become tangent, I think, to a horizontal line a little above the X line. It is a little misleading and puzzling to any one to whom a curve expresses a law, to see this line start so definitely toward the X line as if it were going to get there.

Referring to Fig. 10, which gives Mr. Kennelly's interesting straight line, if I understand that the values of y are given in such units that the unit 1 near the top represents the reluctivity of air, which I suppose is what was meant, it seems to me this line cannot continue to be straight. It would seem that it must tend to become tangent to the unity line: that it must curve off and never get above that line, for if it got above that line we would have a peculiar condition here, because, for such values of H it would follow that if you took the iron out of the field the remaining field in the air would be stronger than when the iron was there. In other words, if you generate a field of that strength with some iron in it, and then take the iron away, the field will be stronger than it was before.

It might have been interesting to have added to these curves the corresponding curve for air, in order to show the relation between them. In Fig. 1 the curve for air would be a straight line very close to the X line, making a very small angle with it. In Fig. 2 the line for air is a horizontal line parallel to the X line, and I think it is the line which this curve approaches as an asymptote. In Fig. 3 the line is also a horizontal line very near the X line. In Fig. 4 it is also a horizontal line, but its location according to the scales used would be very far above this diagram.

Near the end of his paper Mr. Kennelly refers to an analogy with an electric circuit containing an electrolyte. That analogy appears to me to be a very interesting one, and I think deserves a little more attention. It may, perhaps, assist in understanding some of the phenomena. If, for instance, we take two platinum plates in dilute sulphuric acid, and subject them to a difference of potential, beginning at zero and gradually increasing, plotting the value of the E. M. F. as X, and those of the current as Y, we will get a curve very similar to Fig. 1. It will differ slightly at the origin; it will be a little steeper in the ascent and a little sharper at the bend. In this analogy the E. M. F. corresponds to H; the current corresponds to B; the apparent resistance corresponds to ρ, and the apparent conductivity to μ. Carrying out this analogy here, we will find that the liquid will have curves almost exactly like those in Figs. 1, 2, 3 and 4. The curve approaches a horizontal line as an asymptote just as the curve in Fig. 2 does. It starts like that in Fig. 2, has a maximum near the Y line, and comes down in the form of a hyperbola. If this curve is worked out you will find it to be almost exactly like those shown in Figs. 1, 2 and 3. It will also be found to be very similar to that in Fig. 4, only that the line will not be straight. I did not have any definite values from which to work out the curves of this analogy, but assuming the first curve to be something like the one shown in Fig. 1, which will undoubtedly be the case, I worked out all the others, and found they agreed very nearly with the magnetic curves.

Mr. J. Stanford Brown: Mr. Kennelly has spoken of the term "magnetic resistance," and of certain objections which have been made to the term "magnetic resistance." Authorities differ somewhat on the definition of reluctance, and it might be well to call attention to it. In other words, according to some, it is the ratio of magneto-motive force to the total magnetic flux. According to others it is the ratio of magneto-motive force to the flux density. I believe the first definition is due to Hospitalier, in the beginning, and is followed by Prof. Fleming in his "Alternate Current Transformer;" while the other has been followed by Bosanquet and others. If such is the case, it might be well for us to decide here which is the best, and have the institute adopt one or the other as authoritative. It might give us a practical idea of it in another form to remember that in making use of this relationship in motor work or dynamo work we are dealing with ampère turns and the force lines *per unit area*.

Dr. Louis Bell: With reference to the curves Figs. 2 and 3 in the paper just read, I may be able to give a word of explanation. I remember seeing Prof. Rowland use the curve, Fig 3, as a horrible example of the danger of exterpolation beyond the experiments. He supposed, as others supposed, at the time his work was done that the permeability fell down to zero, that there was an end of the power of added force to produce effect; that permeability rose to a certain point and then dropped and stopped there; and it was something of a revelation to everybody when the investigations of Ewing showed that the curve became asymptotic. I had the pleasure of hearing Prof. Ewing read one of the classical papers on the subject at Manchester some three years ago, and it was generally remarked as surprising that the curve did become completely asymptotic. The interpretation to be put then on that particular diagram is that a man has no business to continue the deduced curve beyond the point where his experiments stop, unless he knows what is going to happen, which he seldom or never does.

Mr. Chas. P. Steinmetz: I cannot agree with the opinion expressed here, that the curve of magnetic reluctance does not start from a definite value, but begins at an infinite value. On the contrary, I entirely agree with Mr. Kennelly that the initial point of the curve of magnetic reluctance always must have a finite value. For if you consider the curve of dependence of the magnetism upon the magneto-motive force, the curve given in Mr. Kennelly's paper as Fig. 1, you see that this curve starts in the zero point with a finite angle, different from zero and different from 90°.

Now the magnetic conductivity is the tangent function, the magnetic reluctivity the cotangent function, of this angle; and the angle being different from zero and different from 90°, both functions must have a finite value. That means magnetic reluctivity as well as magnetic conductivity start from a *finite* initial value.

And that the "magnetic characteristic" curve, Fig. 1, of the paper intersects the axis of abscissæ under a finite angle different from zero and from 90 degrees is evident, and proved by the fact that, if you send an alternating current around this magnetic circuit, no matter how much you decrease this current, it will always encounter a *finite* amount of self-induction. Now self-induction of the alternating electric circuit measures the conductivity of its magnetic circuit, and therefrom you prove that this conductivity, and therefore also its inverse value the reluctivity, is *finite*.

I am very much pleased to see that Mr. Kennelly prefers the term "magnetic reluctance" to the term "magnetic resistance," which begins already to be used rather confusedly. For electric resistance is one thing and magnetic reluctance is another thing, and both things have got definite, but different, dimensions, and so we have no right whatever to call them both by the same name, if we do not want to cause confusion. It would even be better not to have the term electrical resistance at all. Even that is very misleading. It was introduced at a time when electrical science was still in a very crude state, and we knew nothing about the dimensions of these quantities, and so it came that the term "electric resistance" was introduced for that quantity which determined the loss of energy caused by an electric current in the same way as in mechanical engineering the term "mechanical resistance" was already applied to that force which consumes in every mechanical motion a part of the energy, by converting it into heat. But now we have the *mechanical resistance*, which is a true force, of the dimensions of *force*, while *electric resistance* is of the dimension of *velocity*, hence quite a different thing; and if we introduce *magnetic resistance* we have another resistance again, of still another dimension, a reciprocal length, and so we have the same name for three different quantities, of different dimensions, which is anything but commendable. There is besides an essential difference between this term "magnetic reluctance" and the two other resistances, because the two other resistances are quantities which really determine the consumption of energy or rather the conversion of energy into heat. But the magnetic reluctance does not convert potential energy into caloric energy. Hence if we want to use the term magnetic resistance at all we would use more appropriately another quantity with this name. In the magnetic circuit a certain consumption of energy takes place too, if the magnetism reverses. Hysteresis consumes energy. I think I shall be able at one of the future meetings to communicate to the institute a number of experimental tests carried out in Mr. Eickemeyer's factory in Yonkers, on determinations of loss of energy by hysteresis, and its dependence upon the intensity of magnetization. These results seem to point to the fact that this consumption of energy by hysteresis can be expressed analytically by one coefficient, and this coefficient would, I think, more properly be called magnetic resistance than any other quantity, because it is really that coefficient which determines the consumption of energy, that is the conversion of magnetic potential energy into heat. It is better to avoid the name "magnetic resistance" altogether. Another point I wish to mention still. As known, elasticity is that physical force which is most analogous to magnetism, so much that almost every phenomenon of elastic forces finds its analogy in the magnetic circuit. This analogy goes even so far that, if Mr. Kennelly mentions that magnetism is able to store up in a given volume more energy than any other force, elasticity even beats magnetism. A twisted steel spring contains a greater amount of stored up energy than a highly magnetized piece of iron or a highly magnetized quantity of air. To mention only the analogy to hysteresis in the elasticity—when a steel spring is twisted it represents a certain amount of potential energy, as any magnetic circuit. Now, untwist this spring and it gives back energy as a magnetic circuit, demagnetized, gives energy back. But if you twist the spring and let it untwist itself, a certain amount of energy is not given back. Just so, if you magnetize a magnetic circuit by the expenditure of a certain amount of energy, which is converted into magnetic potential, and demagnetize it again, it does not give back all the energy, but a certain amount of energy is lost by molecular friction, by hysteresis.

This analogy goes still farther: By twisting or untwisting alternately a steel spring, a certain amount of energy in each elastic cycle is converted into heat by external friction and another amount by molecular friction. The loss of energy by external friction per elastic cycle is proportional to the rapidity wherewith the cycle is completed—to the "frequency." The loss by molecular friction is about constant, and independent upon the rapidity of elastic changes.

Now in the magnetic circuit you have the same: the external friction of the elastic cycle—or the resistance caused by the work done by the spring—corresponds in the magnetic circuit to the induced currents, viz., eddy currents set up by the alternating magnetism. Both are proportional to the frequency of the alternations, and depend upon outside conditions.

To the molecular friction of the elastic cycle corresponds in the magnetic cycle the molecular friction of hysteresis, both dependent upon outside conditions, and apparently upon the frequency. I need not go farther into this comparison, for I shall have to dwell upon it more on another occasion.

Mr. Kennelly says that air has apparently no hysteresis, and this is the general assumption, too. But nevertheless, in the light of modern science we must say that even air has a certain hysteresis, a time hysteresis. For we know now that the magnetic stress in air does not appear instantaneously with its source; but we know that magnetic disturbances are propagated through air with a finite velocity, the velocity of light. Now, if you examine the phenomenon more particularly you will see that then, and only then, no energy would be dissipated in space, if the magnetic disturbance set up at any place would be propagated through the whole space instantaneously. But as soon as the propagation of energy through space consumes a finite time, no matter how small this time be, a certain loss of energy must necessarily be connected therewith, and, calling the retardation of the maguetic disturbance, behind the magneto-motive force, hysteresis, we must say even air has hysteresis.

Mr. Chas. E. Emery: I wish to thank the author for the very valuable information and suggestions contained in the paper, and to express my pleasure with the very scholarly way in which the subject has been presented. I will add a word in relation to the expression 4π, which has been discussed by one of the speakers. In investigating the formulæ for the construction of motors and dynamos it becomes quite evident that 4π is nothing more or less than a simple arithmetical coefficient which, in this connection, has nothing to do with its customary significance as expressing the surface of a sphere of unit radius. It is thought that this should be emphasized by writing the figures instead of the symbol or, for convenience of calculation, substituting a single special character, for instance a, for it, and stating its numerical value. The artificial conception that a line of force radiates from a unit of surface of a sphere of unit radius, may be comprehended so far as the unit is concerned, but has not the slightest applicability in practical work. The conception causes great difficulty in the minds of students, and to it may be very well applied the language used on the second page of Mr. Kennelly's paper, where he refers to "the remarkable construction of purely artificial frameworks of thought, void of all attempt at reality, yet capable of affording useful applications and exact quantitative results," etc. This particular language refers to theories in relation to magnetism, but the books contain very similar expressions in relation to 4π. It should be borne in mind that the criticism is not intended to apply to the electrostatic distribution of potential on the surface of a sphere or other solid, for in such case the surface of the sphere is one of the ele-

* For the full text of Mr. Kennelly's paper, with the figures to which reference is made in this discussion, see THE ELECTRICAL WORLD Nov. 7, 1891.

ments considered, whereas "magneto-motive" force, as it is called by the Committee on Units, has no necessary relation to a sphere or to a system of lines radiating in all directions from a common centre. The coefficient used in connection therewith, which has been called 4π, arises from the same causes that similar coefficients occur in almost all other formulæ, either rational or empirical.

Dr. M. I. PUPIN: I once heard a lecture by a very famous specialist (Prof. Winkler, of the Berlin Polytechnic School), in bridge building and railroad building in general; it was a lecture on designing bridges. He said, if you want to be sure that your bridge will not break down under the load for which it is designed make it three times as strong as your calculations require. Well, as a rule that will never apply to electrical engineering. It would be very foolish to say to a man, if you want a 1-h. p. dynamo make it big enough for a 3-h. p. load. In the very nature of things this difference must exist. In mechanical engineering they do their testing in a way entirely different from that in which the coefficients and units are determined in electrical engineering. Electricity is nothing if not an exact science. Mechanical engineering is not yet a perfectly exact science. Our methods of testing are exceeding exact, and electrical units are derived by very exact and, comparatively speaking, very easy means. We cannot change them. Because a certain quantity has the numerical coefficient 4π we cannot complain of that. God has made the world in such a way that 4π multiplied by the square of the radius equals the surface of the sphere, and that is the reason that 4π appears in our formulæ. (Laughter.)

It is an incommensurable quantity, and that is another bad thing about π, and yet this 4π appears all the time in electromagnetism. It appears on account of our definition of the fundamental units. We define our ampères and volts and ohms, by defining first our units of length, of time, and of mass which leads then to our definition of the units of force and work; we apply then Ampère's fundamental law in electromagnetism and Coulomb's fundamental law in magnetism, and Joule's well known law to obtain our units of current, electromotive force and resistance. Proceeding in this way, we finally discover that, because God made space in such a way that 4π times the square of the radius is equal to the surface of a sphere, for that reason only and no other do we find that if you carry a unit pole once around a wire, through which a current, C, circulates, that the work is $4\pi C$; whether you pass around in a circle or in any curve whatever, the work is equal to $4\pi C$. These few remarks perhaps may serve to point out why the 4π comes up. It is simply due to our units. But we cannot go back and change everything in order to get rid of this 4π, because this 4π will come in somewhere else anyhow.

Mr. KENNELLY: Mr. President and gentlemen, I think it would be better perhaps to clear up the questions which have been raised, with the aid of the blackboard, on these four figures. It was mentioned, I think, that the initial reluctivity could not commence at a definite value, because, if I mistake not, Fig. 2 showed a starting point from zero. Fig. 2, it must be confessed, is erroneous in that respect. The first observation is shown by a black mark, and the line should not be carried back to the zero point. As regards Fig. 3, that does not terminate at the base line. It ends with the two little dots that you see there, and any person is at liberty to continue that line in any direction whatever. The exact direction, of course, will depend upon how you construe the word permeability; whether you mean metallic permeability, or permeability in the mass. There is a difference on the vein theory, because we have seen that the flux is supposed, on this theory, to be the magnetizing flux added to the flux in the metal itself. It dissociates what goes on in the metal from what goes on in the space occupied by the metal, while the ordinary term, permeability, includes both.

In regard to Fig. 4 and also Fig. 10 in the paper, it is quite true that in reluctance, as ordinarily defined, namely, as the reciprocal of permeability, $1 \div \mu$, the line could not go beyond unity, and would stop before the second line from the top of the diagram, Fig. 10. But that is mentioned in the paper. It is also pointed out that if we borrow from the vein theory, the conception that the reluctance in the mass, in the joint reluctance of two things in multiple arc, namely, the metal and the space occupied by the metal (it is an artificial hypothesis—granted; but it leads to a result which is easy to handle), one becomes an asymptote, the other, so far as we know, goes on forever; that is to say, it does not terminate at 24,500. Now, the reluctance of iron is shown at 24,500 to be a little over 1.1—call it 1.2. The reluctance of air is supposed to be constant, namely, unity. The joint reluctance of these two is

$$\frac{1.2 \times 1}{1.2 + 1} = \frac{1.2}{2.2} = 0.545.$$

Now, you see, .54 would be the apparent reluctance of the iron. It shows how very vital a change is introduced by that conception borrowed from the vein theory, for on the conception that there is a metallic reluctance the line becomes straight. The whole object of the paper is to show that whereas the curves of flux in terms of magnetizing force, or of permeability in terms of magnetizing force, or of permeability in terms of flux density, are all complicated curves—they are curves which you would not like to define by any particular formula. The curve which follows from the conception of the inverse of permeability is, fortunately, a very simple one. It is one that although it may have no place in nature, happens to suit our purposes in a high degree. On Fig. 9, the dots there which show the observations indicate that the reluctivity did commence at a definite value, namely, 0.75, in that particular example.

Now, as regards the point that was mentioned of the vein flux having reached its full amount, that arises, does it not, from the fact that the total induction—the total number of lines of force in the metal per square centimetre of section can go on as far as 45,000? Whereas the intensity of the iron, that is to say, on the vein theory, the amount of magnetic material that you would discover by making a cut at right angles to the lines, the amount of magnetic fluid would reach a finite value; in other words, the induction B increases indefinitely, while I, the intensity of magnetization, reaches a maximum.

There is only one other point, I think, that is about this unfortunate 4π. It is a matter sincerely to be regretted that we cannot, in dealing with the simplest magnetic circuits, determine the flux from the magneto-motive force, without the introduction of that very unfortunate coefficient. As has been clearly pointed out by several speakers, it stands in the light of no more than a numerical factor, and is derived from the fundamental fact that the unit of quantity in magnetism is that quantity which would repel its equal with unit force at unit distance.

It would certainly be possible to suppress 4π from the practical side of the work. We could cause 4π to disappear from our equations of electromotive force and flux, but it would turn up in other places. If we force it out of the door, it would come in at the window. The first effect would be that we would have to change all our ohms and volts. That is a task which is surely enough to deter almost any advocate of such a change.

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Chronological History of Electricity, Galvanism, Magnetism and the Telegraph, from B. C. 2637 to A. D. 1888.—Part I.*

BY P. F. MOTTELAY.

(1782–1791 continued.)——No point has hitherto been found at which the needle does not exhibit a *horary* motion, and, since the erection of magnetic stations, the important and very unexpected fact has been evolved that there are places in the southern magnetic hemisphere at which the *horary* variations of the dipping needle alternately participate in the phenomena (types) of the hemispheres.

Humboldt also alludes, in the article on "Magnetic Variation," to his recognition of the "four motions of the needle, constituting, as it were, four periods of magnetic ebbing and flowing, analogous to the barometrical periods," which will be found recorded in Hausteen's "Magnetismus der Erde," 1819, s. 459, and he likewise refers to the long-disregarded *nocturnal* alterations of variation, for which he calls attention to Faraday "On the Night Episode," § 3,012–3,024. (See, also, Poggendorff's *Annalen der Physik*, bd. XV., s. 330, bd. XIX., s. 373.)

The *Phil. Trans.* for 1738, p. 395, contain the description of a new compass for ascertaining the variation "with greater ease and exactness than any ever yet contrived for that purpose." This was devised by Mr. C. Middleton, whose many interesting observations are to be found in the same volume of the *Phil. Trans.*, p. 310, as well as in the volumes for 1726, 1731–1732, 1733–1734 and 1742. Reference should also be made to the volumes for 1754 (p. 875) and 1757 (p. 329), giving the reports of W. Mountaine and J. Dodson upon the magnetic charts and tables of 50,000 observations, likewise to the volume for 1766 containing the report of W. Mountaine on Robert Douglass' observation, as well as for the record of investigations of the variation made by David Ross on board the ship Montagu during the years 1760–1762.

See Sabine, "On the Annual and Diurnal Variations," in vol. II. of "Observations Made . . . at Toronto," pp. xvii.-xx., also his Memoir "On the Annual Variation of the Magnetic Needle at Different Periods of the Day," in *Phil. Trans.* for 1851, part II., p. 635, as well as the Introduction to his "Observations . . . at Hobarton," vol. I., pp. xxxiv.-xxxvi., and his Report to the British Association at Liverpool, 1854, p. 11—*Phil. Trans.* for 1857, Art. 1, pp. 6, 7—relative to the *lunar diurnal magnetic variation.* See, likewise, "Mém. de Paris," vol. II., p. 74, and vol. VII., pp. 503, 530; Walker, "Ter. and Cos. Magn.," chap. III.; Mme. J. Le Breton, "Histoire et Applic., etc.," Paris, 1884, p. 17; Robison, "Mech. Phil.," vol. IV., p. 356; Thos. Young, "Nat. Phil.," 1845, p. 583.

CASSINI FAMILY.

This celebrated family, to which allusion was made under A. D. 1700, deserves here additional notice.

GIOVANNI DOMENICO CASSINI (1625–1712), the first and greatest of the name, succeeded Buonaventura Cavaliéri in the astronomical chair of the Bologna University in 1650, and remained there until given the directorship of the Paris Royal Observatory upon its completion in 1670. Partly with the assistance of his learned nephew, James Philip Maraldi, Cassini made many important discoveries, among which may be signaled the finding of the first, second, third and fifth satellites of Saturn, as well as the dual character of that planet's ring, the determination of the rotation of Jupiter, Mars and Venus, and the laws of the moon's axial rotation. (See Thomson, "Hist. of the Roy. Soc.," p. 331; "Anc. Mém. de Paris," I., VIII., X.; Thos. Morrell, "Elem. of the Hist. of Phil. and Sc.," London, 1827; pp. 377–379.)

JACQUES (JAMES) CASSINI (1677–1756), the only son of the preceding, became director of the Paris Observatory upon the death of his father, made many very important astronomical observations, and wrote several treatises upon electricity, etc. In one of his works, "De la Grandeur et de la Figure de le Terre," Paris, 1720, he gives an account of the continuation of the measurement of Picard's arc of the meridian from Paris northward, begun by Domenico Cassini and La Hire in 1680, and recommenced by Domenico and Jacques Cassini in 1700. (See "Mém. de Paris," vol. VII., pp. 455, 456, 508, 572; and for years—1705, pp. 8, 80, 1708, pp. 173, 292; 1729, Hist. I., Mem. 321.)

CESAR FRANÇOIS CASSINI DE THURY (1714–1784), son of Jacques, whom he, in turn, succeeded at the Observatory, was, as above stated, the father of Jean Dominique Cassini (1747–1845). He made numerous researches while in the Director's Chair, his most remarkable work being the large triangulation of France published in 1744, under the title of "La Méridienne, etc." (See "Hist. de l'Acad. des Sciences de Paris" pour 1752, p. 10.)

A. D. 1783.——Robespierre (François-Maximilien-Joseph-Isidore de), who afterward became leader of the famous French Jacobin Club, and was at the time practicing law in his native town of Arras, distinguishes himself by successfully defending the cause of the Sieur de Vissery de Boisvalé, a landed proprietor of that place, who had erected a lightning conductor on his house, "much to the scandal of the discreet citizens" of the locality—"Deistical philosophy; away with it!" (Eighth "Britannica," vol. XIX., page 233.)

Mr. de Boisvalé's case was on appeal from a judgment delivered by the sheriff of Saint-Omer, ordering the destruction of the lightning conductor, and its printed report bears the following epigraph:

> L'usage appuyé sur les temps
> Et les préjugés indociles
> Ne se retire qu'à pas lents
> Devant les vérités utiles.

See Ronald's Catalogue, page 434; *La Lumière Electrique* for Sept. 5, 1891; the *Electrician*, London, Sept. 11, 1891.

A. D. 1783.——Wilkinson (C. H.), Scotch physician, publishes at Edinburgh his "Tentamen Philosophico," etc., which is followed, during 1798 and 1799, by other works upon electricity, wherein he cites a number of marvelous cures of intermittent fevers similar to those made by Cavallo, also of amaurosis (*goutte sereine*) and of quinsy (*squinancie*) like those performed by Lovet, Becket and Mauduyt.

During the year 1804 appeared the first edition, in two volumes, of his "Elements of Galvanism in Theory and Practice," containing a very comprehensive review of the discovery from the time of the early experiments of Galvini. In this last named work, however, he shows that incipient amaurosis and the completely formed gutta serena have not yielded to his own treatment by galvanic influence, as had been the case with Dr. C. J. C. Grapengieser, who published many accounts of surprising cures. (Grapengieser, "Versuche den Galvanismus . . . ," Berlin, 1801 and 1802, or Brewer and Delaroche, "Essai . . . ," Paris, 1802.) The whole of chapter XXXVI. is devoted to the application of galvanism to medicine, whereto allusion had already been made in the first chapter of the same work.

Wilkinson refers also to the electricity of the *torpedo*, and to the observations made thereon by Hippocrates, Plato, Theophrastus, Pliny and Aelian, as well as by Belon, Rondelet, Salviana and Gesner, and by Meisschenbrock, Redi, Réaumur, Walsh, Hunter, Spallanzani, Sgravesande, Steno, Borelli, Galvani and others. Much space is likewise given to the observations recorded on animal electricity, notably by Fontana, De La Méthérie, Berlinghieri, Vassali-Eandi, Humboldt, Pfaff, Lehot, Halle, Aldini, and to the experiments of Valli, as they were repeated before the French Academy of Sciences and before the Royal Society of Medicine of Paris, in presence of Mr. Mauduyt. When treating of the powers of galvanism as a chemical agent, reference is made to the decomposition of water, thus first effected in 1795 by Creve, the discoverer of metallic irritation, and to the operations of Nicholson and Carlisle, Dr. Henry, Cruikshanks, Haldane, Henry Moyes, Richter Gibbes, etc.

See J. J. Hemmer, "Commentat Palatinæ," vi., Phys., page 47; Berthelon, "Elec. du Corps Humain," 1786, vol. I., pages 314, 330, 483, and vol. II., page 299; *Annales de Chimie*, vol. LXXVIII., page 247; *Phil. Mag.*, vol. XXIX., page 243, and vol. XLIX., page 299; F. Buzzi, "Osservatione . . . amaurosi . . . elettricita," Milano, 1783 ("Opus. Scelti," vol. VI., page 359); *Nicholson's Journal*, vol. X, pages 30-32, for letter relative to certain erroneous observations of Mr. Wilkinson respecting galvanism, written by Mr. Ra. Thicknesse, who also wrote in vol. IX., pages 120-122, explaining the production of the electric fluid by the galvanic pile.

* Continued from THE ELECTRICAL WORLD of Nov. 14, 1891.

A Recent Legal Decision.

The following opinion was rendered Nov. 9, 1891, in the United States Circuit Court for the Northern District of Illinois, in the case of the Western Electric Company vs. the Electrical Construction Company and Gustav A. Harter:

Jan. 12, 1891, injunction ordered in this court restraining defendants from infringement of patent No. 148,447,

granted March 10, 1874, to Augustus Hahl, and patent No. 172,993, granted Feb. 1, 1876, to Elisha Gray.

The devices covered by these patents are what are known as electric annunciators for elevators or lifts in buildings, being the annunciators in common use in the cabs of passenger elevators whereby signals are given from each floor by means of a signal key which connects with a flexible electric cable attached to the cab, or with a vertical strip or wire extending from the bottom to the top of the elevator well. Since the injunction was granted the Hahl patent has expired, and the injunction may be said to have lapsed so far as that patent is concerned. But the Gray patent of Feb. 1, 1876, has yet some time to run. The Hahl patent covered the flexible cable. The Gray patent was for "The combination of a movable elevator car, annunciator attached thereto and moving therewith, circuit closing and breaking signal keys on different floors, and mechanism whereby an electric current is maintained between the signal keys and annunciator without interruption by the movement of the car." These two patents were before this court in Western Electric Company vs. Chicago Electric Manufacturing Company, 14 Federal R., 691, and both patents held valid. Proof shows defendants had notice of the injunction, and also shows that during the month of May last, and while the injunction remained in full force as to the Gray patent, defendants put an electric annunciator into the Haymarket Theatre building in this city, which was a direct infringement of the claim of the Gray patent, that is, the annunciator is attached to the cab and moves therewith, has circuit closing or breaking signal keys on each floor, and a mechanism whereby an electric circuit is maintained between the signal keys and the annunciator without interruption by the movement of the car. This claim is very broad, and the main fact that the Hahl patent on the flexible cable has expired does not allow the use of an annunciator which is attached to the cab and moves with it and is connected by means of signal keys at each floor with an electric circuit. The defendants have therefore violated the injunction and thereby are guilty of contempt of the order of the court. Fined $50 and costs.

Barton & Brown for complainant. J. H. Whipple for defendants.

Annual Report of the West End Street Railway.

The fourth annual report of the West End Street Railway Company, of Boston, was presented at the annual meeting of the stockholders Nov. 12. An abstract of the report is given herewith. President Whitney in his address referred to the delay in making up the report, offered a suggestion in regard to changing the date of the annual meeting to March 1, the fiscal year to end Jan. 1, or to some date that would give more time between the end of the fiscal year and the date of the annual meeting. He stated that no benefit had been derived from the large power plant up to the end of the fiscal year. Since Oct. 12 power had been taken from this plant for the Tremont street lines. It would be next year before the benefits received from the large power plant would be visible. The East Cambridge plant would be in operation Dec. 15. Till then, as now, power would be bought from the Cambridge Electric Light Company. He urged the stockholders to inspect the large plant, and assured them that they would find that it had been secured at the minimum price. He also called attention to the superiority and economy of electricity as a motive power, and to the fact that there had been no purely electric accidents during the year, and that the fear of electricity as a motive power had disappeared.

It may be set down, he said, as a settled fact, that the electric system is a safe one; that it has passed through its transition state, and that the employés are becoming familiar and experienced in its use. Accidents by electric are no more frequent than by horse cars, and it was his impression that they will be less, for he could see greater care by the motor men, and by the community, and he was sure that those two factors will lead to an absolute reduction of the proportion of accidents.

The address to the stockholders, as submitted by President Whitney, stated that they believed that it is now well-nigh universally admitted that for the propulsion of street cars the electric system is to be the established system for the future; and that, in spending the money for a plant that is calculated to produce a very large amount of power in the most economical way, they had consulted the best interests of the company and of the community. There is also the advantage of the greater reliability of the system and the greater freedom from accidents, which are considerations of prime importance when the whole system is to be run by electricity. The further introduction of the long cars is one of the important events of the year. A year ago there were but few of the long cars running, most of the electric cars then in use being of the short pattern, supplemented by tow cars. The cost of running the long cars is about the same as that for the short cars, while the increased earning capacity, as well as the increased accommodation for the community, are considerably greater. The increase in earnings during the past year has been mainly in the places where the electric system is in operation. The lines which have heretofore been electrically equipped have mainly been the long and unprofitable horse car lines, while the lines now being equipped are the shorter and more profitable ones of the system.

It is the purpose of the company to proceed with the establishment of the electric system over its lines as rapidly as possible, and before the 1st of January to add 175 more long cars to the electric system. The cars have been ordered, and have been promised in season to accomplish this, and the car houses and the track will soon be ready. If this is done, the mileage of the electric system having been about one-fourth of the whole mileage during the past year, the mileage for the present year will be something more than one-half the whole mileage, or about 9,000,000 miles. The company is now charging to its operating expenses, for depreciation in horses, the same amount as when the entire system was operated by horse power. Besides this, the increased cost of provender alone for the last year, even with the reduced number of horses, has been about $119,000 over that of the previous year.

In the earnings of the lines operated by electricity there has been a steady, and in some cases a most surprising, increase. While in the original change from horse power to electricity there was a large increase in earnings the continued operation of the electric system on these lines has resulted in continued gains.

Considering the greater earning power of the long cars, and the additional number of these cars that are being put on, together with the general increase in the business, it is believed that the company will be easily able to meet its dividends on the increased stock, with a considerable surplus for extraordinary expenses.

The directors submitted the following statement and report, covering the operations of the road for the year ended Sept. 30, 1891:

Gross earnings		$5,968,984.47
Operating expenses		4,445,559.59
Net earnings		$1,523,424.88
Fixed charges were as follows:		
Taxes	$245,734.63	
Rent of leased roads	11,842.20	
Coupon interest	170,500.00	
Miscellaneous interest	117,039.18	
Total fixed charges		545,116.01
Balance available for dividends		$978,308.87
Against which the dividend charges were as follows:		
Eight per cent. dividend on preferred stock	$512,000.00	
Five per cent. dividend on common stock, Jan. 1	175,000.00	
Five per cent. dividend on common stock, July 1	201,317.50	
Total dividend charges		888,317.50
Balance of net income carried to surplus account		$89,991.37

The income account shows a debt balance for the year of $89,991.37, and a total of $5,968,984.47. The credit side shows the receipts from passengers to have been $5,889,180, from manure, $15,864; rent of tracks, $13,401; rents of real estate. $20,937; advertising, $28,903, and from miscellaneous sources, $699.64. The credit balance carried to next year is $214,661. The depreciation in car equipment charged off during the year was $214,661. The percentage of operating expenses to the gross income is 74.4 per cent., as against 73.25 per cent. last year.

The treasurer's report gives the balance sheet as of Sept. 30, in comparison with last year as follows:

Assets.	1891.	1890.	Inc.
Construction	$5,516,994	$5,309,173	$207,821
Real estate	6,650,564	5,796,548	854,106
Equipment	458,139	423,161	34,978
Horses	910,664	928,248	17,554
Cars	1.258,818	1,300,997	52,179
Electric cars	1.396,929	1,192,048	204,881
Electric equipments	597,048	436,643	160,405
Power station equipment	488,682	293,939	194,743
Cash assets	2,704,052	3,845,353	1,141,901
Totals	$19,981,982	$19,536,660	$445,322
Liabilities.	**1891.**	**1890.**	**Inc.**
Common stock	$7,137,100	$3,491,150	$3,645,950
Preferred stock	6,400,000	6,400,000	.....
Stock subscriptions	12,250	2,008,850	1,996,600
Funded debt	4,272,000	4,034,442	237,558
Notes and accounts	1,945,971	3,246,659	1,300,688
Profit and loss surplus	214,661	355,558	140,897
Totals	$19,981,982	$19,536,660	$445.322

The company now owns 244.47 miles of track, leases 14.63 miles and operates all told 259.817 miles. Of this number 81.234 is equipped with the electric overhead system, and 18.907 is partially equipped. The cars ran 17,462,572 miles during the year, made 2,328,274 round trips, and carried 119,264,401 passengers.

The average receipts per passenger were 4.938 cents. The total mileage of the electric cars was 4,588,146, or 26.27 per cent. of the whole, and of the horse cars 12,874,426, or 73.73 per cent. There was 8.18 miles of track rebuilt during the year, at a cost of $152,076.15, of which amount $61,350 was charged to the construction account, and $70,726 to the surplus account.

The construction account has been charged for the year with $207,821.36. The net addition to the real estate account—power, plants, etc.—has been $439,405. The horse car account has been reduced $52,159; the electric car account increased $204,881.24, and the general equipment account increased $34,979. The power station equipment has been increased $194,743, and the electric line equipment charges have amounted to $160,404.95.

Upon taking a vote for directors for the ensuing year the following were elected to succeed themselves: G. T. W. Braman, Eustace C. Fitz, Samuel Little, Isaac T. Burr, Joseph S. Fay, Jr.; Henry D. Hyde, E. D. Jordan, Dexter N. Richards, Walter S. Swan and Henry M. Whitney.

T. Jefferson Coolidge, Walter Hunnewell, Theophilus Parsons, Nathaniel Thayer and William Powell Mason were elected to succeed Elisha S. Converse, Jonas H. French, Asa P. Potter, Charles O. Foster and Nelson Bartlett.

An Electric Light Support.

The illustration shows an electric light support, which is designed to render lights adjustable to any desired position within certain limits, and is especially adapted for use in mechanics' shops and other places where it is desirable to bring the light to bear upon several sides of an object without moving the object. It consists of an extensible lamp-supporting arm, hung by a ball and socket joint from the ceiling of a room, so that the lamp may be adjusted to and held in any desired position, until forcibly moved to a new position.

It is equally well adapted for use on a wall bracket, and is

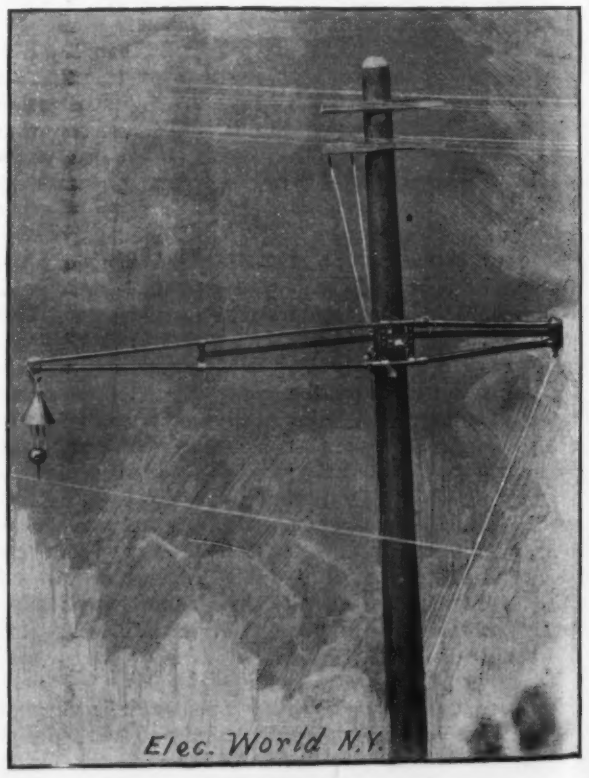
An Electric Light Support.

considered very useful as a light support for machine shops, mills, shoe manufactories and all places where an adjustable electric light is wanted. It is manufactured only by R. Hollings & Co., manufacturers of lamps, gas fixtures and electroliers, 547 Washington street, Boston.

An Automatic Mast Arm.

The illustration shows an automatic mast arm designed for electric street lights.

It is made with a lateral or sidewise movement, so as



An Automatic Mast Arm.

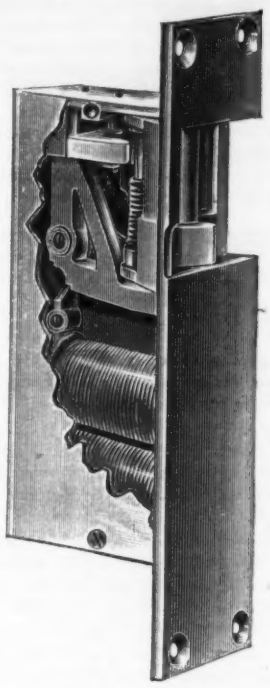
to let the lamp pass a trolley or other wires, without interfering with the same, as the lamp when let down will be at the side of the pole, where it can be cleaned and the carbon replenished.

No climbing of poles is required, as the arm is counterbalanced, the forward part being constructed of gas pipe or tubing, weighing about 30 pounds, the rear part being five feet long and constructed of solid round iron, the combined weight of both parts being about 55 pounds. The arm is

built cannon shape, set edgewise, which adds to its strength. The wires run through the hollow tubing, a centre plate being riveted to a duplex hinge, which is provided with a catch, which keeps the arm in position when it is raised. The arm and lamp is raised or lowered by means of a short line connected on the ring of the right and left hand line, which is provided with a snap for attaching or detaching it. By this arm no wires hang down or are to be seen except as connected at the pole. It is manufactured by the Keystone Automatic Mast Arm Works, of Allegheny, Pa.

Electric Door Opener.

The accompanying illustration shows an electric door opener, which is designed to be operated on doors where

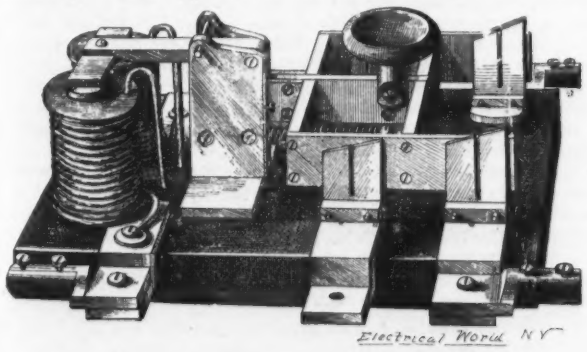


AN ELECTRIC DOOR OPENER.

self-closing springs are used, as the latch remains released after pressing the button until the door is opened. The closing of the door resets the opener automatically. It is fully encased, has binding screws for attaching wires and the parts liable to wear are made from steel. No "throw out" spring is required and it can be operated with a very small battery. A large number of these openers are already in use and it is stated are giving general satisfaction. They are manufactured by the Manhattan Electrical Supply Company, 36 Cortlandt street, New York.

New Automatic Switch and Cut-Out.

We do not often have a chance to illustrate a switch having apparently so large a range of usefulness as the automatic switch and magnetic cut-out shown in the illustration. The very annoying troubles that often occur on account of the "blowing of fuses" on motor and railway circuits, and the frequent armature "burn-outs" (which are not only troublesome, but also expensive), it is claimed can be remedied by the use of this switch. It consists of a practical double pole switch mounted on a slate base, which is designed to replace the ordinary switch used to connect the main feed (supply) wires to a motor. Attached to it is a simple magnet, connected to the main switch terminals, and mounted on the same slate base; the armature of this magnet, being attached to the end of a lever, operates a



AUTOMATIC SWITCH AND CUT-OUT.

trigger and allows the switch to be thrown open by the action of a strong spring when the trigger is operated. Its construction is such that, while the motor is in operation and doing normal work, the switch remains closed. It frequently happens, however, that the same supply current is cut off, for a few moments, perhaps, by the breaking of a trolley, or supply wire, or the switching of generators (or some other reason), while the motor is still connected to the circuit, and thereby the motor is instantly "stalled." If, then, the current is again turned on, the rush of current will very likely burn out the armature, as the motor still has its load on and the armature cannot start quickly enough to prevent this danger of burn out, or in any case would undoubtedly do considerable damage on account of the great spurt in speed. Also this great rush of current through all motors brings sad results on the generating dynamos; either blowing main fuses or burning out armatures. The operation of this switch in such an event would instantly automatically cut off all current to the motors, and thereby prevent all of the above troubles; accomplishing these results without using any complicated or additional device, as it takes the place of the switch commonly used.

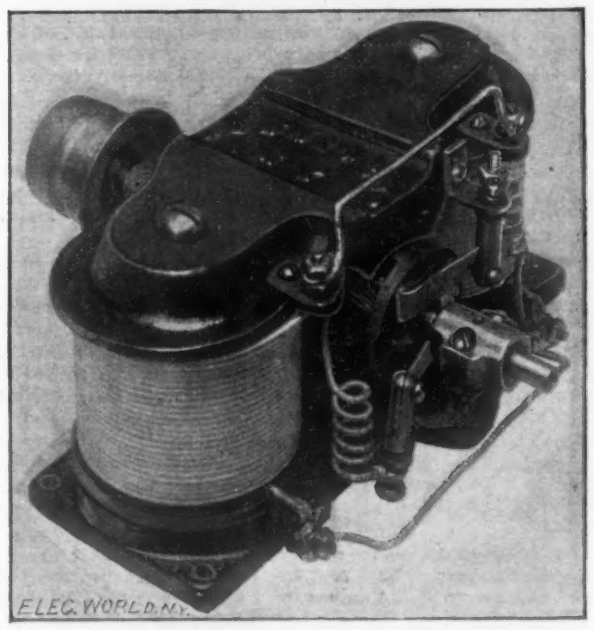
It can be used as a magnetic cut-out for the protection of dynamos, either arc or incandescent, against any accident that may occur to the main lines; the switch working automatically and instantly breaking the current on any sudden increase of the current beyond the safe output of the dynamo, thus protecting the same from any accident that may occur. These switches are manufactured by the Hunt Engineering Company, of 126 Liberty street, New York.

Model Dynamo Electric Machine.

The accompanying illustration shows a model dynamo electric machine, designed for the use of students, amateurs and youths whose ingenuity may lead into electrical investigations. They are made in rough castings or finished complete, and in three sets. Set A consists of castings and all material, except wire, comprising cast iron pole pieces, armature core and driving pulley, steel shaft, soft iron magnet cores, composition armature bearings and caps, commutator sections, vulcanized fibre commutator, washer and insulating pieces, brass brush holders, connecting screws, nuts, etc.

Set B consists of the above with magnets bored, armature turned down and grooved, all holes laid out and drilled. Set C is considered the best for amateurs, and consists of the above parts all completed and ready to be put together, or put together ready to generate current. In the armatures No. 20 wire is used, and No. 23 magnet.

To the student in electricity these model machines will be of interest, furnishing, as they do, practical experience



THE WEED MODEL DYNAMO.

in construction and winding. They are designed for actual use, all wearing parts are adjustable, and they will generate sufficient current to light two or more ¼-candle incandescent lamps, the number depending on the speed of the armature, which may be driven at 3,000 revolutions per minute with safety by one of the numerous model engines which are on the market, or from any piece of machinery, and the wires carried to a distance, thus giving the light in the desired location.

A great number of interesting experiments may be performed with these machines, such as driving small electric motors, charging permanent and electro magnets, decomposing water, ringing gongs, etc., for which purpose the dynamo may be arranged to run by hand power or from a sewing-machine flywheel. The machine complete occupies a space 6 x 6 inches, is three inches in height, weighing about seven pounds, and is entirely harmless, as it supplies a current only equal to three or four battery cells.

They are manufactured by A. J. Weed & Co., of 106 Liberty street, New York.

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Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

The Closing Quotations of electric stocks on Saturday, Nov. 14, 1891, in New York and Boston were:

Name of Stock.	Par.	Capitalization.	Bid.	Ask'd.
Western Union Telegraph Co	100	86,200,000	82½	82⅞
American Telegraph & Cable	100	14,000,000	....	80
Central and South American	100	5,000,000	....	....
Mexican	100	2,000,000	....	....
Commercial Cable Co	100	7,716,000	....	....
Postal Telegraph Cable	100	5,000,000	28	33
Edison General Electric	100	15,000,000	94	95
Consolidated Electric Light	100	2,500,000	20	30
Edison Illuminating Co., New York	100	4,500,000	80	81
" " " Brooklyn	100	750,000	75	78
" " " Boston	100	1,263,500	97½	102½
" " " Chicago	100	750,000	135	145
U. S. Illuminating Co	100	1,250,000	30	35
North American Phonograph Co	...	.....	2	4
New York Phonograph Co	100	6,200,000	2½	4
Edison Elec. Light Co. (of Europe) stock.	100	2,000,000	2½	5
" " " " bonds	...	30,000	65	75
" Ore Milling Co	100	2,000,000	17½	22½
" Toy Phonograph Mfg. Co	10	1,000,000	½	1
U. S. Electric Light Co	100	1,500,000	....	20
Brush Illuminating Co., of New York	50	1,000,000	40	50
Mt. Morris Electric Light Co	...	500,000	....	60
East River Electric Light Co	100	1,000,000	....	60
Thomson-Houston Electric Co	25	6,000,000	45½	46½
" " preferred	25	4,000,000	25	26
" International Electric Co	100	1,000,000	....	200
Thomson Electric Welding Co	100	1,000,000	....	....
" European Electric Welding Co	100	1,500,000	....	60
Westinghouse Electric Co., assented	50	7,000,000	10	11
Fort Wayne Electric Co	25	4,000,000	12½	13

Chicago Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on electrical stocks as follows:

TELEPHONE STOCKS.

Chicago	$212@ $220	Cumberland	$60@ $62
Central Union	51@ 52	Wisconsin	118@ 120
Michigan	81@ 83	Bell of Missouri	175@ 180
Great Southern	30@ 32	Iowa Union	20@ 22
Colorado	34@ 36	Missouri and Kansas	54@ 56
Rocky Mountain Bell	40@ 43		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$97@ $99	Chicago Edison Co	*$139@$145

*Ex Rights.

NEW INCORPORATIONS.

The Chicago Electric Carriage Company, of Chicago, propose to manufacture electric carriages, motors, etc.; capital stock, $100,000; incorporators, W. O. Worth, Louis J. Pierson and Hugh McIndoe.

The Atlas Electrical Manufacturing Company, of Chicago, proposes to manufacture dynamos, motors, etc.; capital stock, $12,000; incorporators, M. F. Matteson, Q. A. Stephenson and J. B. Albertson.

The Allegan Light and Power Company, of Allegan, Mich., with a capital stock of $10,000, has been formed to prosecute the business of electric lighting and manufacturing. I. P. Griswold Arthur F. Marsh and James H. Dewing are the organizers.

The San Angelo Light, Power and Irrigation Company, of San Angelo, Tex., with a capital stock of $20,000, has been incorporated to supply light and power to the public, etc. E. Dugan, P. N. Jones and W. A. Guthrie, all of San Angelo, are the promoters.

The Bellefonte Street Electric Railway, of Bellefonte, Pa., with a capital stock of $18,000, has been organized to operate a street railway by electrical power in Bellefonte. L. A. Schafer, W. F. Reeder and James M. Potter, all of Bellefonte, are the promoters.

The Western Telegraph and Electric Company, of Ouray, Colo., with a capital stock of $100,000, has been organized to build a telegraph line from Ouray to Red Mountain, in Ouray County, Colo. L. L. Bailey, J. J. Burns and B. Brooks are the incorporators.

The National Electric Brush Company, of Portland, Me. with a capital stock of $500,000, has been formed to manufacture and sell brushes, and particularly electric hair brushes. Elmer F. Robinson, Rupert J. Chase and Alex. Stanton, all of Lynn, Mass., are the promoters.

The Early Electric Light Company, of Richmond, Wayne county, Ind., with a capital stock of $25,000, has been formed to operate an electric light plant, and to sell electric light in the city of Richmond, etc. Chas. Morris, W. N. Gray and Geo. P. Early, are interested therein.

The Queens County Light and Power Company, of Oyster Bay, N. Y., with a capital stock of $50,000, has been organized for producing electricity for electric light, heat and power. Wm. A. Vail, Horace Ironmonger and Zachariah Latshaw, all of Brooklyn, are the incorporators.

The Wolverton Arc Electric Light Company, of New York, with its principal office at Newark, N. J., and a capital of $250,000, has been organized to manufacture and operate electric lights. J. E. Wolverton, W. McCubbin and J. N. Cox, of New York City, are the organizers.

The Electric Appliance Company, of Chicago, Ill., with a capital stock of $30,000, has been incorporated to manufacture, buy and sell goods and merchandise and electrical appliances, supplies and apparatus. The promoters are Charles S. Grover, Benj. F. March and Wm. H. Joplin.

The Crown Electric Manufacturing Company, of Bridgeport, Conn., with a capital stock of $10,000, has been started to manufacture and sell all kinds of electric goods, apparatus and supplies, etc. E. L. Smith, C. J. Norton and F. H. Bryant, all of Bridgeport, are those interested.

The Proctor Electric Fleet Company, of Chicago, Ill., with a capital stock of $30,000, has been incorporated to manufacture, fit out and run a fleet of electric barges for the purpose of carrying passengers. David R. Proctor, Hollis D. Holden and Harry H. Myres are the promoters.

The Lancaster & Strasburg Railway Company, of Lancaster, Pa., with a capital stock of $125,000, has been organized to operate a street railway by electric or other than locomotive power. Jacob B. Long, J. W. B. Bausman and Walter M. Franklin, all of Lancaster, are the organizers.

The Montrose Electric Light and Power Company, of Montrose, Pa., has been incorporated, with a capital stock of $12,000, to furnish light, heat and power by means of electricity to the public at Montrose. J. N. Taylor, O. A. Gilbert and J. D. Jenkins, of Montrose, are the promoters.

The Gardner Electric Light Company, of Gardner, Mass., has been incorporated, with a capital stock of $30,000, to generate and distribute electricity for supplying light, heat and power. Roderic L. Bent, F. S. Whittemore, Henry Heywood, Geo. Heywood, H. F. Richardson, Chas. C. Bent and R. L. Bent are the organizers.

Tamaqua and Lansford Street Railway, of Tamaqua, Pa., with a capital stock of $50,000, has been started to operate a street railway by electric power in Schuylkill County, Pa. D. D. Philips, of Gordon; Robert Harris, of Tamaqua, and C. R. Eberle, of Philadelphia, Pa., are the incorporators.

The International Electric Railway Company, of Chicago, Ill., has been incorporated with a capital stock of $2,500,000, to construct and operate electric railways and to manufacture electrical appliances and furnish electric light and power. The organizers are J. T. Hanna, M. M. Wood and Demas L. Coe.

The Ohio Gas Fuel Company, of Chicago, Ill., with a capital stock of $5,000,000, has been formed for the purpose of manufacturing and selling gas, the manufacture and sale of electricity for light, power and other purposes, etc., etc. Thurston G. Hall, Hiram H. Hall, Patrick Dowling, and L. E. Dancey are the promoters.

The Triple Multiplex Company (incorporated in West Virginia), with a capital stock of $1,000,000, has been formed to manufacture and sell electrical and mechanical devices, inventions and machinery. George Doyle, S. T. Appolonio, J. A. Z. Wyman, E. B. Crane and William Baily, all of New York, are shareholders.

The Astoria Electrical Manufacturing Company (incorporated in West Virginia), of New York, has been organized, with a capital stock of $500,000, to acquire, hold and grant license, letters patent, etc., and to dispose of the same. C. N. Jordan, William Steinway and Edward Uhl, of New York, are the incorporaters.

The Connecticut Smokeless Fuel Gas Company, of Chicago, Ill., has been organized with a capital stock of $1,500,000 to manufacture, supply, sell or distribute gas, electricity or other products for the furnishing of light, heat, fuel and power. Thurston G. Hall, Luke T. Drury and Calvin C. March are the incorporators.

The Latrobe & Derry Electric Street Railway Company, of Latrobe, Pa., with a capital stock of $40,000, has been formed to operate a street railway by electrical or mechanical power in Latrobe. John W. Hughes, John B. Miller, C. O. Slater David J. Bush and James E. Heckall, of Latrobe, are the incorporators.

The Mitchell Electrical Railway Cable Company (incorporated in West Virginia), of New York, with a capital stock of $5,000,000, has been incorporated to manufacture and deal in electric cables, and selling and leasing the rights to use the same. W. A. Taylor, J. A. Lindsay and J. W. Forrest, all of New York, are the promoters.

The Santa Paula Water-Works, of Santa Paula, Cal., with a capital stock of $150,000, has been formed to construct water-works and utilize water power, to generate electricity and other power. Wallace R. Hardison, Nathan W. Blanchard, C. H. McKevett, Lewis A. Hardison and Dan C. Gailey, all of Santa Paula, are the incorporators.

The Fairmont Investment and Construction Company, of Fairmont, W. Va., with a capital stock of $250,000, has been incorporated for the purpose of acquiring real estate, erecting and operating electric lights, planing mills, etc. O. J. Sands, T. F. Hall and W. A. Clayton, all of Fairmont, are the organizers.

The East Liverpool & Wellsville Street Railroad Company, of Cleveland, O., with a capital stock of $300,000, has been organized to construct, maintain and operate an electric street railroad between East Liverpool and Wellsville, O. The promoters are A. L. Johnson, Sidney H. Short, C. E. Grover, L. A. Russell and Wm. B. Bolton.

The United States Rapid Transit Company, of Chicago, Ill., with its principal office at Chicago, and a capital stock of $5,000,000, has been formed to build, equip and operate, etc., mechanical and electrical constructions and devices for the rapid transit of the United States mail, passengers and merchandise. The organizers are John Irvine, Isaac T. Dyer and Frank O. Anderson.

The Wilder Duplex Electric Burglar Alarm and Messenger Company (incorporated in West Virginia), of New York, with a capital stock of $500,000, has been formed to prosecute the business of manufacturing the burglar alarm invention patented by E. R. Wilder. Ferdinand Fersch, I. N. Heidelberg and Morris Mayer, all of New York, are the organizers.

The Edison Light and Power Company, of Newark, N. J., with its principal office at Newark, N. J., has been formed with a capital stock of $1,000,000, to construct, own, maintain, and operate power stations and works for the manufacture, production, distribution, etc., of electric currents. Thos. A. Edison, of Orange, N. J.; Moses Biglow, Leslie D. Ward, Elias S. Ward and Henry Young, all of Newark, N. J., and Burd Grubb, of Edgewater Park, N. J., are the promoters.

AFFAIRS OF THE COMPANIES.

The Rochester (N. Y.) Electric Light Company has increased its capital stock from $100,000 to $250,000.

The Illinois Valley Electric Light and Power Company has recently purchased the electric lighting plant of the Marseilles (Ill.) Street Railway and Electric Light Company, and has entire control of the lighting of the town.

The Hawaiian Electric Company, Limited, of Honolulu, was organized recently and elected the following officers: William W. Hall, president; William V. Lockwood, vice-president; Jonathan Austin, treasurer; E. O. White, secretary; T. May, auditor.

St. Paul, Minn.—The Northwestern Electric Construction and Supply Company has filed articles certifying that its corporate name has been changed to the Northwestern Thomson-Houston Electric Company. The principal office is at St. Paul. The capital stock is $1,500,000, of which $569,700 is actually paid in.

The Taylor Electric Light, Gas and Power Company, of Taylor, Tex., has elected officers and directors as follows: President, E. W. Pike; vice-president, J. E. Tucker; treasurer, J. A. Thompson; secretary, F. L. Welch; directors, J. E. Tucker, C. Mendel, John Threadgill, E. W. Pike, F. L. Welch, Hugh Burns and J. A. Thompson.

The McKeesport Light Company, at its recent annual meeting, elected officers and directors as follows: Thomas Reynolds, of Reynoldton, president; J. W. Risher, of Dravoesburg, vice-president. The election of a treasurer and secretary was postponed until the next meeting. The directors are A. M. Neper and L. H. Silverman, both of Pittsburgh, and Messrs. Adams and Darling, of New York.

The Thomson European Electric Welding Company has issued a circular to stockholders, in which it is stated that after the payment of the dividend of $25 per share the company has assets of $80,000 cash, all of the continental patents and the stock in the British company, which consists of £78,334 common shares and £3,760 founders' shares. The directors contemplate selling the patents and stocks in the treasury, and an agent of the company is now in London for that purpose.

The Payson Electric Light and Power Company, of Provo City, Utah, has sold its plant to the Payson Electric Light and Manufacturing Company, a new corporation under the laws of the Territory of Utah, for the purpose of furnishing light, heat and power. Power will be furnished night and day. The new company is incorporated for $10,000, with 65 per cent. paid in, balance as soon as required. The following are the officers of the company: T. E. Daniels, Jr., president and electrician; John Done, Jr., vice-president; James A. Daniels, secretary; George W. Hancock, treasurer; Abraham Done, superintendent; George Finlayson, manager.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-177 Times Building. New York, Nov. 16, 1891.

Mr. H. H. Harrison has started on an extended business trip through the West in the interests of the Lieb Machine Works.

Mr. I. George Kaelber, of Rochester, N. Y., representing the Western Electric Company, was in the city last week on a business trip.

The American Society of Mechanical Engineers will hold a reception at the Lenox Lyceum, corner Madison avenue and Fifty-ninth street, on Thursday evening, Nov. 19, commencing at 9 o'clock.

Mr. Ernest A. Des Marets, representing the W. S. Hill Electric Company, of Boston, has opened an office in room 518, in the Electrical Exchange building, 136 Liberty street, and will look after the interests of his company in this city.

Messrs. Clarence E. and Geo. S. Beach, of the Clarence E. Beach Electrical Supply Company, of Binghamton, N. Y., called at the office of The Electrical World last week. They were in New York several days calling upon the various supply houses.

Mr. G. C. Baillard, formerly New York City representative of Alexander, Barney & Chapin, has accepted a position with Parmly, Mitchell & Co., manufacturers' agents and dealers in electrical merchandise, of 18 Cortlandt street, and will act as their city salesman.

Mr. Thos. Towne, for many years buyer for the E. E. Garvin Machine Company, of New York, has taken the Eastern agency of the Union Drawn Steel Company, with an office in the Electrical Exchange Building. This company makes a specialty of cold die rolled steel and iron shafting, piston rods, pump rods, etc. Mr. Towne is a hustler, and expects to work up a large market for his goods in the electrical field.

The Board of Electrical Control, at a recent meeting, authorized the Empire City Subway Company to construct new subways for telephone and telegraph service in certain specified districts. The Consolidated Telegraph and Electric Subway Company was also authorized to construct subways for electric light service in certain districts specified by the board. It was moved by the mayor, and carried, that all district messenger companies be compelled to put their wires under ground. W. H. Brown, of the United States Electric Light and Power Company, asked for an extension of time for his company to take its wires down. The application was rejected and the wires ordered down.

New York Electrical Society.—The above society has long been noted for organizing novel and instructive entertainments, and the secretary has now arranged for another most interesting evening, which will be spent in visiting the New York City Fire Alarm Headquarters, at 157 East Sixty-seventh street. On Thursday, Nov. 19, at 8 P. M., Mr. J. Elliot Smith, the efficient superintendent in charge of the electrical department, will be on hand, and the members will be afforded every opportunity of seeing the manner in which alarms are received, transmitted and attended to, and will thus understand how it is the fire telegraph service of New York enjoys its high reputation at home and abroad. It is believed that this is the first time that an electrical society has ever visited the Fire Headquarters, and the opportunity is likely to be taken advantage of by a large number of members and their friends.

Notes on the Frankfort Electrical Exhibition.—At a joint meeting of the American Institute of Electrical Engineers and the Electric Club to be held at the club house, 17 East Twenty-second street, Tuesday evening, Nov. 24, Mr. Carl Hering will present a paper entitled "Notes on the Frankfort Electrical Exhibition," illustrated with lantern slides. Mr. Hering was chairman of the delegation of the American Institute of Electrical Engineers to the Electrical Congress, and was given every facility to thoroughly investigate all departments in the exhibition. To those who were not able to visit Frankfort, this occasion will afford the best possible opportunity for obtaining full information from an intelligent and expert observer. Through the courtesy of the officers of the Electric Club, the privileges of the house will be extended to all members and guests of the institute who may present the usual notice of meeting issued by the secretary.

Hon. W. R. Vaughan, of Chicago, was an agreeble caller at the office of The Electrical World last week. Mr. Vaughan is an enthusiast in regard to electrical matters, and has from time to time been interested in promoting several large central stations, having put in the first electric lighting plant in Des Moines and Council Bluffs, Ia., and Omaha and Ashland, Neb. He is at present interested in a humanitarian issue, the pensioning of ex-slaves, and is the author of Vaughan's Ex-Slave Pension Bill, which was introduced at the last session of Congress by the Hon. W. J. Connell, of Omaha, Neb. He impresses one with the sincerity of his work and is devoting every effort to the furthering of the cause which he is championing, and is meeting with some considerable success. He is a gentleman who is fearless in whatever he undertakes, never recognizes the possibility of failure, and should receive the cordial support of those who are in a position to help win for the ex-slaves that which in justice belongs to them.

The New York Electric Club will have one of the most interesting and important meetings of the current season in a short time. Mr. Rosewater, the well known proprietor and editor of the Omaha *Bee*, one of the leading newspapers of the West, went this year to Europe to study the various systems of government telegraph there. He made a very exhaustive investigation and was the more able to do so from the fact that he is himself an old telegrapher who made an enviable record as a member of the U. S. Military Telegraph Corps during the war. He is now president of the Old Timers' Telegraph Association. Mr. Rosewater has recently returned to this country and will review the results of his observations before the New York Electric Club in two or three weeks' time. Mr. Rosewater, it is understood, was specially recommended to the care of the various European governments by our own State and Post-Office departments, and the occasion, therefore, will be one of the first importance, especially as Mr. Rosewater, who is an eloquent advocate of placing the telegraph under national control, believes that the facts and evidence in his possession fully justify the stand taken on this subject. Members of the club will receive due notice of the date. N. H. 2d.

PHILADELPHIA NOTES.

Branch Office of The Electrical World,
927 Chestnut St., Philadelphia, Pa., Nov. 14, 1891.

Wm. T. Pringle & Co., manufacturers of The New Era Burner, report that their business is looking up and that the demand for burners, etc., was never better.

"The Trinity."—Messrs. William H. Weston, George W. Weston and Albert E. Plowman, of Wm. H. Weston & Co., consulting and manufacturing electricians, are always busy, and their genial efforts and untiring devotion to the interests of their patrons always bring results.

Mr. Daniel Spruance, president of the Star Electrix Company is on an extended trip to San Francisco. He had arrived at St. Louis when last heard from and reported business in a fine condition, with collections slow. The genial Marshall is in charge of the home business and acknowledges he has all he can do.

The Imperial Electric Company has recently started in business at 1,218 Filbert street. The company is composed of Mr. J. S. Spraunce, president; Mr. J. C. Corbit, Jr., secretary and treasurer, and Mr. John Mustard, general manager. They report making very satisfactory progress, and realize a difficulty in manufacturing rapidly enough to meet the demand.

The Pennsylvania Electric Engineering Company is a new company which has recently started in business, with offices in the Penn Mutual building. The personel of the company is Mr. Arthur L. Bosley, president, and Mr. Lewis R. Schultz, formerly associated with Mr. C. M. Blanchard, treasurer. The company will do engineering and contracting for any class of electric work, equiping electric lighting and power stations, and furnishing supplies to plants already in operation. They report a most gratifying business from the start.

J. W. Parker & Co., of 38 South Fourth street, mechanical engineers and selling agents for Ball engines, have sold within a month engines to the following companies: The Thomson-Houston Electric Company, Boston, Mass., one 250-h. p. cross compound condensing engine for electric railway duty at Brockton, Mass.; the Johnstown Electric Light Company, Johnstown, Pa., one 200-h. p. Standard engine for electric lighting; the Columbia Electric Light Company, Philadelphia, Pa., one 200-h. p. Standard engine for electric lighting; the Lock Haven Electric Light and Gas Company, Lock Haven, Pa., one 150-h. p. Standard engine for electric lighting. J. W. Parker & Co. contract for and furnish complete steam plants for electric light and electric railways, and make a specialty of the Ball engine.

A severe and very interesting test was made recently by Wm. Sellers & Co., of this city, upon a motor operated under the new principle invented by Mr. H. Ward Leonard. The motor used was a 10-h. p. standard shunt-wound Sprague motor. Its normal speed was 1,500 revolutions a minute. It was belted to a countershaft, and upon the countershaft was placed a brake, and in addition to the brake there was placed upon the countershaft a large flywheel such as is used upon punching machines, the purpose of the flywheel being to duplicate the inertia and momentum met with in practice in a great many kinds of work. The motor was made to operate in either direction at any rate of speed desired, and it was found possible to run it perfectly and regularly under the full brake load, at 15 revolutions per minute, that is, one per cent. of its full speed. While operating at full speed in one direction the motor could be instantly reversed, the reversal being perfectly gradual and entirely without any spark or troublesome feature of any kind. In order to get the most marked effect in overcoming the momentum of the flywheel the brake was taken off and when the flywheel was running at its full speed of 300 revolutions a minute the motor was reversed instantly. In 13 seconds it had brought the flywheel to rest, and in 13 seconds more had it running at full speed in the opposite direction, the entire operation being effected with the greatest smoothness and without any spark whatever. Its performance was extremely satisfactory to all concerned and showed its adaptability to any class of work to be met with in practice.

James M. Queen & Co. announce that they are about to remove their offices and show rooms from their old stand at 924 Chestnut street to new and larger quarters at No. 1010 on the same street, where they expect to be located after Dec. 15. This change has been made necessary by an increased demand for space to store apparatus, and also because by the move there will be much better facilties for exhibiting instruments to the large and increasing number of scientists and electricians who visit their establishment each year. The entire building contains 26,000 feet of floor space, which will be heated by steam and lighted by electricity. For these purposes a very complete plant is being installed, which will comprise two boilers of 40-h. p. capacity each, two Westinghouse compound engines of 60-h. p. total capacity, one 400-light incandescent dynamo, motors for running elevators and for special work, and the apparatus for steam heating. The departments of philosophical, electrical and chemical apparatus will occupy the entire second floor, extending through from Chestnut street in front to Sansom street in the rear, covering a floor space of 5,300 square feet, which will be well lighted and ventilated. It is of great assistance when selecting apparatus for a laboratory to examine the individual instruments and judge of their merits by personal contact, and in the new quarters all instruments will be so arranged and displayed that the least time need be consumed in selecting an outfit, or, if desired, in

a special room which will be appropriately equipped for the purpose, the various pieces may be tested and proved, to determine that they properly perform the required experiments. This latter innovation will be appreciated, for very often it is desired to show to a customer the working capabilities of an instrument under consideration, but for want of a suitable place it would be impracticable to do so. In the new "experimental room," water, gas and electricity will be at command, and the working tables will be arranged so that such experiments can be performed satisfactorily and quickly. The other departments of the business, comprising optical, mathematical, engineering, meteorological, microscopical and photographic apparatus, will be distributed in other parts of the building, where the different instruments will be displayed to best advantage. The factory will remain at 819 Filbert street, where it occupys 7,500 square feet of floor space and gives employment to 75 men and boys. It is the intention of Queen & Co. to have everything arranged so that they can attend to the details of their business in the best manner possible, and they extend a cordial invitation to their friends to call and examine the appointments of their new store, after they have moved into it, and see what has been done. F. J. D.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Nov. 14, 1891.

Beverly (Mass.) has a hose wagon fitted out with electric lights with storage batteries.

Barre (Vt.) is to have an electric company called the Granite City Electric Company, for heat, light and power, with extensions to Williamstown and Orange.

Mr. L. H. Rogers has sold within two weeks three complete central station plants for the Thomson-Houston company. When there's anything in sight L. H. usually gets it.

The Shipman Engine Company has just shipped an engine to Odessa, Russia, for a 20-light electric plant. The result of an inquiry from an ad' in THE ELECTRICAL WORLD.

An addition to the Thomson-Houston works in Lynn will soon be erected. This addition will be for the accommodation of the increasing car building business. The company is also considering the erection of a new building for the winding department.

Mr. E. I. Garfield, secretary of the Thomson-Houston Electric Company, has returned from his extended western trip. He has been gone just 38 days, and during that time has visited San Francisco, Tacoma, St. Paul, Denver, etc., and reports having had a very pleasant trip.

The Pettingell-Andrews Company is having unprecedented success with its new triple braid P.-A. wire, the sales of which have been something phenomenal. Large sales are reported in K. W. main and branch cut-outs, so well known throughout the country. Business generally is exceedingly brisk. C. A. B.

SOUTHERN NOTES.

NORFOLK, Va., Nov. 14, 1891.

Pulaski, Va.—An electric light plant will shortly be erected.

Newport News, Va.—It is reported that the town will shortly be lighted by electricity.

Aiken, S. C.—An electric light plant has been put in the works of the Aiken Pine Fibre Company.

Chase City, Va.—An electric light plant is now in contemplation. The mayor can give information.

Carrollton, Ga.—The electric light plant of H. Lanier has been purchased and will be operated by the city.

Roanoke, Va.—Two new boilers have been added to the plant of the Roanoke Electric Light and Power Company. This company will also supply power for the Vinton dummy line.

Wheeling, W. Va.—Authority has been petitioned for by the Edison Electric Light, Heat and Power Company to lay underground wires, and to construct a system to cost $500,000.

The Georgia Railroad Commission has notified the Telegraph and Express Company to forward them rate sheets, rules and regulations. These rates will be studied by the commissioners, and representatives from each company will be given a hearing, after which they will provide rules and regulations to govern the business of these companies. V. N. B.

WASHINGTON, D. C , Nov. 14, 1891.

A Grand Electric Illumination.—Mr. A. A. Thomas, president of the United States Electric Lighting Company, of Washington, D. C., is chairman of the committee on illumination of the organization recently effected in the capital city for the purpose of taking charge of the arrangements for the reception and entertainment of the Grand Army of the Republic when that body meets in Washington next year. Mr. Thomas says that his committee proposes to give the veterans, their friends and the citizens of Washington something in the illumination line that will be worth coming to Washington to see, and which, once seen, will never be forgotten. Both the arc and incandescent light will be used and each of the great electric light companies is now preparing plans to suggest their ideas of what they think the proper method to be pursued. If there are any arches on Pennsylvania avenue they will be brilliantly illuminated, incandescent bulbs by the thousand resting among the folds of the flags, banners, palms and flowers, and in the decorations. So also when large pictures of great generals are displayed lights will be arranged so that they can be exhibited to the very best advantage. Special attention will be directed toward the illumination of all public buildings. In this part of the illumination the electric flash light will play an important part. Many of these lights with a power equal to 14,000 candles, such as are used on men-of-war, will be utilized. Mr. Thomas' idea is to use this light every moment or two by casting it upon the public buildings. With the search light playing upon it from some suitable elevation, the Capitol can be made to stand out a brilliant picture, a palace of marble against a background of dense black that will surpass in effect any view ever had of it. A similar result will be had with all the other public buildings A. E. O.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Nov. 14, 1891.

Mr. Geo. H. Meeker, Western manager of the New York Insulated Wire Company, is at present making a trip through the South in the interest of the Chicago store.

The New York Insulated Wire Company, for its Chicago branch, has recently fitted out a handsome new truck, which is a conspicuous sight on the streets, bearing the familiar signs of Grimshaw White Core Wire and loaded with vulca wire ducts.

The pier extending 1,000 feet from the World's Fair grounds into the lake is already completed. At its extremity, in place of the Casino, will be erected a tower 250 feet high. This will be of iron, and will resemble a lighthouse in appearance. From its summit electrical displays of exceeding brilliancy will be made, and by means of electric search lights the grounds, or any particular portion of them, can be flooded with light.

Mr. James I. Ayer now has two 3,000-light alternating incandescent machines in operation in the municipal station at St. Louis, and will gradually have the remaining machines in service, making a total dynamo capacity of 30,000 incandescents.

Mr. S. G. Booker, manager of the Fidelity Carbon Manufacturing Company, of St. Louis, Mo., has just returned from an extended trip through the Southeast and East, visiting points in Virginia, his native State, and bringing back some handsome orders.

Mr. W. H. Hill, manager of the Hil Clutch Works, of Cleveland, O.; Mr. Gardner C. Sims, of Armington & Sims, Providence, R. I.; Mr. W. H. Wheeler, manager of the Eclipse Clutch Works, of Beloit, Wis.; Mr. George C. Bailey, manager of John A. Roebling's Sons Company, of Chicago, and Mr. W. H. Lahman, of Kirkwood grate bar fame, of Chicago, were at the Southern Hotel this week.

The Columbia Incandescent Lamp Company, of St. Louis, Mo., has received orders averaging more than a thousand lamps a day thus far this month, and is working its force night and day to keep up with the demand for its lamps. The Columbia company now carries a line of lamp sockets for the various systems, and also a stock of branch blocks in order to accommodate its customers desiring these goods. H. DE L.

LINCOLN, Neb., Nov. 12, 1891.

The Question of Electric Lighting is being agitated at Geneva, Neb.

The Grueter Furniture Company has purchased a 5-h. p. motor to run its pump.

The Gaynor Fire Alarm System has been accepted by the council. Mr. F. Berewith is in charge.

The Wymore Electric Light Company, Wymore, Neb., is increasing the number of lamps on its arc circuit.

The Episcopal College, Lincoln, Neb., is to be lit up with 300 16-c. p. incandescent lights. Bids are now being received.

The Lincoln State University has added a school for telegraphy to the already finely equipped electrical department.

The Wisconsin Furniture and Coffin Company has purchased an electric elevator which will lift 2,500 pounds 40 feet per minute.

Mathew O'Reilly, formerly superintendent Lincoln Electric Light Company, has opened a general repair shop and will soon be in a position to do business.

The Nebraska Insane Asylum is being rewired by the Lincoln Electric Manufacturing and Supply Company. This is the oldest plant in the State, of the Mather system.

The Y. M. C. A. Building is being wired for 560 16-c. p lights. The work is rapidly nearing completion, and the building bids fair to be one of the most complete electric lighted structures in the State.

The New Omaha Thomson-Houston Electric Company is being quite freely censured by the local press because of its neglect in getting the suburban district lit up as contracted for by the city last July.

Harry M. Miller, who contemplated the purchase of an electric light plant at Fairbury, Neb , has accepted a position with the Lincoln Electric Manufacturing and Supply Company. He is now installing a central station at Wilber, Neb.

The Lincoln Gas Company has purchased the power plant from G. A. Bush. It will be continued under the name of The Commercial Elect. Power Company. The plant has a capacity of sixty-seven kilowatts, and, from present indications, it will soon be necessary to duplicate the machinery.

The New Lansing Theatre is rapidly nearing completion. The system of electric lighting is to be the most complete of anything in the country. H. Askin, who designed and superintended the construction of the plant, made a special trip to Chicago to get the latest novelties and effects in theatrical lighting, and has succeeded in making this a model plant throughout. The building has 1,134 16-c. p. lamps and is to be lighted from the central station of the Lincoln Electric Light Company. In the cellar of the Opera House are to be placed five massive transformers having a capacity of 300 16-c. p. lights each. These transformers were specially manufactured by the National Electric Manufacturing Company, of Eau Claire, Wis. H. A.

CANADIAN NOTES.

OTTAWA, Nov. 14, 1891.

Amherstburg, Ont.—A by-law authorizing the introduction of electric light for street lighting purposes has been passed by the rate payers of this city.

Brandon, N. W. T.—The Brandon Electric Light Company is putting in a 100-h. p. engine, and a 50-light dynamo. This will make the capacity of the station about 2,000 lights.

Morrisburg, Ont.—The Morrisburg council has granted the privilege of putting up electric light poles and wires to the Reliance Electric Light Company, of Waterford, which is to be put in previous to Dec. 15.

The Canadian Electrical Society may be revived during the coming season. The electric light convention recently held in Montreal seems to have infused new life into some of the former leading members of the society.

Montreal.—The Royal Electric Company has taken proceedings asking to be reinstated in the possession of its contract for the lighting of the wharves, which has been transferred to the Drummond-Claxton syndicate, and claims $500 damages from said syndicate.

Windsor, Ont.—The Ontario *Official Gazette* contains notice of application for incorporation of the Citizen's Electric Lighting Company, of Windsor, Ont. The first directors are W. C. Turner, T. A. Bourke, Windsor, and Ellwood T. Hance, Detroit. The other applicants are James E. Connelly and Charles Joslyn.

New Westminster, B. C.—Tenders are called for boilers and machinery for the electric works of the corporation as follows: two 80-h. p. tubular steel boilers, 60 inches diameter and 16 feet long, one 150-h. p. nominal high speed automatic engine, one McAvity inspirator No. 40, about 50 feet of 16-inch leather belting (oak tanned), about 40 feet of 16-inch do., one smoke stack, 40 inches diameter and 70 feet long, one National feed water heater, 200 h. p., and other fittings. F. D. J.

ENGLISH NOTES.

LONDON, Nov. 4, 1891.

Electric Launches.—An electric launch seems likely to become an indispensable adjunct to every seaside resort. At least three well known seaside towns are proposing to have a small fleet of them for the next summer season. As mentioned in a recent cablegram, the General Electric Power and Traction Company are preparing to place several launches on the Manchester Ship Canal.

The Annual Report of the Postmaster General for the year 1890-91, which has recently been issued, contains some interesting figures relating to the telegraph service. The number of telegrams continues to increase, but the rate of increase is gradually diminishing, as is also the average length of each message. The Postmaster General attributes the falling off in the rate of increase and the diminution of the average length of the messages to the increasing use of the telephone.

Electric Lighting in the South of London.—The foundation stone has been laid of a 20,000-light central station from which it is proposed to supply the neighborhood surrounding the Crystal Palace, from which the station is about 1¼ miles distant. The system adopted is that of continuous current transformer sub-stations, feeding into low pressure mains. It is proposed in the first instance to transmit 500 h. p. electrically to the Crystal Palace, in connection with the Electrical Exhibition, which will be opened there on the 1st of January.

An Electromagnet for Chronographs.—In a recent number of the *Philosophical Magazine* a Mr. F. J. Smith gives an account of some interesting experiments carried out by him with a view of discovering the best form of electromagnet for use in chronographs. It has long been known that under certain conditions twisted iron wires untwist themselves when magnetized longitudinally, and it occurred to Mr. Smith that a light pointer attached to such a wire would be a good way of rapidly indicating sudden alterations in current strength, and he has found this to be the case.

Coast Telegraph Communication.—The agitation for connecting the chief lightships and signaling stations by telegraph or telephone with the general system of the country, which has been raging fitfully for the past five years, has recently received considerable impetus by several sad wrecks which have occurred within the last few months, and there seems every likelihood that the matter will once more be brought before Parliament. It is nothing less than scandalous that a measure so necessary to the security of our merchant marine and the safety of the kingdom in time of war should be played with as it has by the various government departments.

Electric Lighting in Lighthouses.—As I informed you in a recent letter the Association of Master Mariners has lodged complaints at the Trinity House with regard to the various alleged defects and inconveniences of the electric light in lighthouses. The subject has also received some attention in the French technical press owing to the determination to fit the electric light gradually in all the lighthouses along the coast of France. It is asserted that the experience of French mariners shows undeniably that the electric light is less penetrating in fog than good oil light, and it is also pointed out that what is wanted of a lighthouse is not that it should illuminate the path of a ship, but that it should furnish a luminous point in order that the captain may get his bearings.

New Central Station of the St. James & Pall Mall Company.—According to the published returns of the St. James & Pall Mall Company, a revenue of over £21,000 has been earned at the Mason's Yard station for the first three-quarters of the present year, as against £5,627 for the whole of 1890. To meet the increasing demand for light, this company has commenced a new station to supply the northern portion of its district. The three magnificent 300-h. p. Siemens dynamos, coupled direct to Willans engines, which have attracted a considerable amount of attention for the past three months at the model central station laid down at the Naval Exhibition, have been purchased by the company for their new station. It is also contemplated to supplement these by two sets of 600-h. p. steam dynamos.

Answers to Correspondents.

Questions to be answered in this column must be of general electrical interest, and must be accompanied by real name and address as a guarantee of good faith. No notice will be taken of questions regarding apparatus unless enough details are given to permit a definite answer, and no dynamo or motor designing will be done.

Armature Winding.—(1) I would like to know how a Thomson-Houston arc armature is wound. Why is it wound in three sections? (2) Is the number of bars in the commutator limited by the capacity of the machine? (3) Can the Thomson-Houston machine be reversed without altering the connections, and if not, why? (4) What is the main purpose of compound winding of a machine; does it give a higher efficiency? P. L. R.

(1) See S. P. Thompson. It is an armature that an amateur should never attempt to meddle with, as it is very difficult to wind. There is no particular reason for three sections, except the general system of connections employed by the inventors. (2) An arc dynamo can be built with any number of sections in the commutator, independent of the capacity. (3) Any arc machine can be reversed, but a number of minor changes are always required, depending mainly on the regulating apparatus. (4) To supply additional regulating force to compensate for the increased fall of potential in the armature under heavy load and armature reaction. It has little or no effect on the efficiency.

News of the Week.

THE TELEGRAPH.

The Western Union has put in an extra line between Bartow and Punta Gorda, Fla., for commercial purposes.

Knoxville, Tenn.—A company has been formed which contemplates building a telegraph line to Sevierville.

Roanoke, Va.—The direct line between the chief office of the Norfolk & Western Railroad in Philadelphia and the chief office in Roanoke has been put in operation.

The Postal Telegraph Company has opened its office for business in Davenport, Ia., and inaugurated the first service by taking messages of the last election.

The Pacific Postal Telegraph Company.—Work is progressing rapidly on the line which is being put up between San Diego, Cal., and Los Angeles, and it is expected everything will be ready for its operation by Jan. 1, 1892.

New Telegraph Line.—B. Brooks, manager of the Western Union Telegraph Company, J. J. Burns, superintendent of transportation of the Denver & Rio Grande, and others have organized a

company to build a telegraph line from Ouray, Col., to Red Mountain, a distance of ten miles, along the Silverton railway.

Hamilton, Tex.—The Hamilton-Hico Telegraph Company has been organized, with a capital stock of $2,500, for the purpose of building and operating a telegraph line between Hamilton and Hico. The officers are E. A. Perry, president; J. E. Secrest, secretary and treasurer; J. T. James, J. L. Spurlin, Thomas Emmett, Frank Fisher and Joe Williams, directors. Material for construction has been ordered. The company intends to have the line built and put in operation at once.

THE TELEPHONE.

A telephone line is proposed between Sioux Falls, S. Dak., and Sioux City, Ia.

The Troy, N. Y., Telephone and Telegraph Company has decided to adopt the number system which is in use in many other cities.

Lawrence, Kan.—A new long distance telephone has just been invented by Prof. L. V. Blake and E. W. Caldwell, of the University.

The New England Telegraph and Telephone Company, of Portland, Me., is putting its wires underground and expects to have the work completed by Dec. 1.

The Southern Bell Telephone and Telegraph Company, of Atlanta, Ga., it is stated, will erect a new telephone exchange building just as soon as permission is given to place the wires under ground, an ordinance for which has already been introduced in the City Council.

Work on the long distance telephone line between New York and Chicago is being rapidly pushed through Northern Ohio and it is expected that by January it will be in operation between Cleveland and New York. The main line passes through Cuyahoga Falls and Ravenna, where work is now in progress, and a branch will be built from the former point to Cleveland. A line is now in operation as far west as Erie and Newcastle, Pa. A line between Cleveland and Detroit is projected to be built next summer.

A New Telephone Company.—The following are the directors of the Shaver Telephone Company of Fulton and Hamilton counties, New York, recently incorporated with a capital stock of $25,000: Charles H. Ball, Charles O. Cross, M. B. Northrup, Frank Miller, John T. Selmser, of Johnstown; Asa B. Bellis and T. G. Foster, of Gloversville. The general route of the line will be from Johnstown to Gloversville, Broadalbin, Mayfield, Northville, Wells, Sageville and to each and every dwelling house and place of business in Fulton and Hamilton counties.

Richmond, Va.—A fire recently occurred in the telephone central office, which proved very disastrous. The wires in the switchboard were burned out and the board seriously damaged. The origin of the fire was due to the fact that some wires heavily charged with electricity—probably those of the electric light company—fell upon the telephone wires, which were not so heavily charged. The fire department was called out and the flames were soon extinguished. Not one of the 1,100 telephones in the city has been in use for several days. The damage will amount to several thousand dollars, with no insurance.

No Extension for Bell.—The report was general last week that the Bell telephone patent had been extended for an additional fourteen years. It was met with a very prompt denial, however, from Mr. Simonds, the Commissioner of Patents, who stated that no patent has recently been granted the Bell company through which it could secure the benefits of extension. The Commissioner has no power to continue a patent. An application must first be made to Congress, and no patent can be extended except upon the recommendation of Congress. For several years it has been an almost unbroken rule of the Patent Committee that no patents of this nature shall be allowed. None were favorably reported during the last Congress. The Bell company is constantly getting patents, however, on improvements, and it is assumed by those familiar with such matters that the patent which has been issued, if any, or the action which has been taken, is the result of one of the long pending interference cases, both sides of which are said to be owned by the Bell Telephone Company. The reliance of the company for the future is said to be in the sufficiency of the inventions of Emil Berliner and Thomas A. Edison, for which applications were filed in 1877 and 1879, to take the place of the Bell telephone now in use, on which no patent will expire in 1893. The only important litigation still pending with the company is the case of the United States vs. Bell, which, it is said, is liable to hang on for years. The effect of the report upon the stock of the company was strong on the prospects of the reported issuance of the patent extension.

THE ELECTRIC LIGHT.

Granville, O.—An electric light plant will be put in soon.

Granville, O.—The town will soon have electric lights.

Bridgewater, Va.—An electric light plant is reported as nearly completed.

Monroe, La.—An electric light plant will be constructed by W. A. Bright.

Aledo, Ill.—The Aledo Electric Light and Power Company is to erect a plant.

Washington, N. C.—An electric light plant will be erected by Caleb Sterling.

Mt. Sterling, Ky.—An electric light and gas plant will shortly be established.

Elizabeth City, N. C.—An electric light plant is to be erected by Boston capital.

Staunton, Va.—Negotiations are being made for erecting an electric light plant.

Brightwood, Ind.—Citizens are considering putting in an electric light plant.

Spring Valley, Ill.—The city officials are considering the electric lighting question.

Santa Paula, Cal.—The Union Oil Company is putting an electric light plant in its refinery.

Joplin, Mo.—The Merchants' Electric Light and Motor Company is to establish a new plant.

Point Pleasant, W. Va.—Mr. Snyder will put a new engine and dynamo into his electric plant.

Racine, Wis.—The Horlick Food Company is installing a 70-light incandescent lighting plant in its factory.

Cedartown, Ga.—An electric light plant will be erected by Hartford, Herbert & Co., of Chattanooga, Tenn.

Brockton, Mass.—An Edison electric light plant has recently been installed in the factory of George C. Snow.

Chippewa Falls, Wis.—The Chippewa Falls Water and Lighting Company has put its new plant in operation.

Florence, Ala.—A new dynamo will be put in the plant of the Florence Gas, Electric Light and Power Company.

Marshall, Ill.—An electric light plant is being put in by C. C. Travis, of the Owosso, Mich., Electric Company.

Dillsburgh, Pa.—F. E. Baily, contractor of the electric light plant, expects to have it ready for operation soon.

Rock Island, Ill.—T. J. Robinson has been appointed receiver of the Rock Island Brush Electric Light Company.

Farmington, Ill.—The town is to have electric lights, so decided by the Common Council at a recent meeting.

Waco, Texas.—Two 750-light dynamos and a 150-h. p. engine will be put into the plant of the Waco Gas Company.

Fort Valley, Ga.—An electric light plant will be put in by the Fort Valley Investment and Improvement Company.

Pulaski, Va.—Contract for a complete plant has been let to the Thomson-Houston Electric Company, of Boston, Mass.

Waltham, Mass.—The Waltham Gas Light Company has added a new 300 h. p. engine to its electric light plant.

Homer, Mich.—The electric light plant will soon be in operation. The system adopted is the Heisler incandescent.

North Danville, Va.—The Virginia & North Carolina Heat and Light Company will erect a plant to light the town.

Hurley, Wis.—The Gogebic Electric Light Company is increasing the capacity of its plant for incandescent lighting.

Blandinsville, Ill.—The town has an electric light plant in operation, furnishing 40 street and 260 commercial lights.

Maywood, Ill.—The Mawood & Proviso Electric Light and Power Company is putting in a new engine and dynamo.

Bridgeport, Conn.—The Bridgeport Electric Light Company will soon add several dynamos and more power to its plant.

Shelbyville, Tenn.—The electric light plant formerly operated by E. Shepherd is now being operated by Russells & Espy.

Royer's Ford, Pa.—A company is being formed with a capital of $10,000, for the purpose of erecting an electric light plant.

El Paso, Ill.—Work on the electric light plant is being pushed, with the prospects in favor of its being put in operation soon.

Aiken, S. C.—An electric light plant will be put in the Aiken Pine Fibre and Bagging Company's factory at Croft's Station.

Westminster, Mass.—Artemas Merriam has placed an Edison dynamo of 120-light capacity in his shop for lighting purposes.

Bartow, Fla.—The City Council has granted a franchise to the Bartow Tube Well Works to establish an electric lighting plant.

Maywood, Ill.—The Maywood and Proviso Electric Light and Power Company is to add a new engine and dynamo to its plant.

Carroll, Ia.—The Carroll Electric Light and Power Company is considering the matter of adding two more dynamos to its plant.

Braddock, Pa.—An electric light plant of 40 Wood arc lights has been installed at furnace No. 2 of the Corrie Furnace Company.

Alliston Forge, Va.—Machinery for an electric light plant has been received, and the plant will be put in operation as soon as possible.

Milford, N. H.—The Souhegan Electric Light and Power Company has contracted to light the streets of Wilton, five miles distant.

Morristown, Tenn.—A controlling interest in the Morristown Electric Light and Power Company has been sold to Wood Bros. for $11,300.

Horton, Kan.—The Citizens' Light, Heat and Power Company has ordered a new dynamo and contemplates giving an all-night service.

Ashland, Ky.—A 750-light Westinghouse incandescent dynamo is to be put in the plant of the Ashland Electric Light and Power Company.

Paola, Kan.—There is a possibility that an electric lighting plant may be put in by John Francis, of New York City, and others interested.

Wellsville, N. Y.—A citizens' electric light company is being organized for the purpose of furnishing light to business places and dwellings.

Milton, Wash.—The proposition to bond the town for $10,000 for the putting in of an electric light system, etc., was carried by a large majority.

Allegan, Mich.—Allegan and Kalamazoo capitalists have organized a company for the purpose of erecting an electric light plant in Allegan.

Lacon, Ill.—Edwin L. Jeffrey, of Chicago, has made a proposition to the City Council in regard to putting in an incandescent electric light plant.

Orange, N. J.—The Common Council has awarded a five-year contract to the Essex County Electric Company to light the city at $100 per lamp per year.

Little Rock, Ark.—A franchise has been given H. G. Allis, H. P. Bradford and H. M. Taylor for erecting and operating an electric light, heat and power plant.

Worcester, Mass.—The Wright & Colton Wire Cloth Company has put an electric light plant in its factory, which has a capacity of 350 16-c. p. lights.

Quakertown, Pa.—Citizens will vote Dec. 29 on the proposition of bonding the town to the amount of $15,000 for the purpose of erecting an electric light plant.

Columbus, Ind.—Henry C. Bailey, representing a syndicate of Chicago capitalists, has been granted a franchise for ten years for operating an electric light plant.

Elizabeth, N. C.—The electric light company has been displaced by a Northern company, which agrees to furnish light within one month after receiving contract.

Farmington, Mo.—The town is now lighted by electricity from a plant owned by the Hockaday-Carter Company. Twenty lights of 32 c. p. are furnished for $600.

Livingston, Mont.—The Livingston Electric Light Company is putting in a new 35-arc light dynamo and an incandescent machine, having a capacity of 1,350 lights.

Monroe, N. C.—It is reported that a $25,000 electric light plant and ice factory will be established by the Southern Ice and Cold Storage Company, of Chattanooga, Tenn.

Rutland, Vt.—The Rutland Electric Light Company has recently received a new 50-light arc dynamo, two incandescent machines of 650 lights capacity each, and two 500-volt motors.

Montgomery City, Mo.—The Montgomery City Electric Light Company has recently started its plant. It has a contract with the city for thirty 32-c. p. street lights. The National system is used.

Cumberland, Md.—The Cumberland Electrical Company has organized, and will lease and operate the Gephardt foundry and electrical works. The capital stock is $100,000. J. S. Humbird is president.

Bartow, Fla.—F. J. Maywald, Frank Clarke and C. J. Seeger have incorporated the South Florida Electric Company, for the purpose of constructing telephone lines, erecting electric light plants, fire alarms, etc.

Brenham, Tex.—The electric light plant for the McFadden compress is being placed in position, and an incandescent outfit for the branch store of A. H. Harrison has been received and will be put in running order soon.

Lyons, Ia.—The Common Council has voted to sell the city electric light plant to a private corporation, and has accepted the proposal made by Bliss & Sodden, of Chicago, to buy the plant subject to being ratified by a vote of the people.

Waynesboro, Va.—A franchise to erect an electric light plant has been granted the Waynesboro Street Railway, Light and Water Company, and the contract for the same has been let to the Fort Wayne Electric Company, of Fort Wayne, Ind.

Jacksonville, Fla.—The Southern Gas Trust and Construction Company, of Jacksonville, controlling and operating the Palatka Gaslight and Fuel Company, and the Gainesville Gas and Electric Light Company, has been placed in the hands of G. Loper Bailey, of Palatka, as receiver.

Stafford Springs, Conn.—The company recently chartered for building an electric light plant at Stafford Springs has been reorganized, and the project will be pushed rapidly. The company is composed of R. S. Hicks, of Stafford Springs; A. M. Young, of Waterbury, and E. H. Jacobs, of Danielsonville.

Mobile, Ala.—The special committee appointed by the General Council to investigate the question of a municipal electric light plant met recently and reported. It was moved that the committee lay the facts before the Common Council asking authority to have specifications drawn to be submitted to the General Council as a preliminary to asking for bids for the erection of an electrical plant for lighting the city.

Long Island City, N. Y.—The Long Island City Illuminating Company has been granted the privilege of doing electric lighting in the city. The certificate of incorporation of the new company was only filed with the Secretary of State last week. The capital is $50,000, and the directors are Edward M. Tyrrell, of Brooklyn; James W. Lamb and William A. Christian. Mayor P. J. Gleason is said to be interested in the new company.

THE ELECTRIC RAILWAY.

Macon, Ga.—It is stated that a new electric line is contemplated.

Bristol, Va.—Six miles of the new electric line are completed and cars have commenced running.

Salem, Va.—A new electric railway will be commenced soon by the Salem Street Railway Company.

Augusta, Ga.—The capacity of the Augusta Railway Company's plant will be increased.

Attalla, Ala.—Electric cars are to supersede the dummy on the line between Attalla and Gadsden, Ala.

San Francisco, Cal.—The park commissioners contemplate building an electrical road to Golden Gate Park.

Columbus, Ga.—The new electric street car line is nearly completed. It will be operated by the overhead system.

Wilmington, N. C.—The Wilmington Street Railway Company, it is stated, will change its lines to an electric system at once.

Macon, Ga.—Bonds of the Macon City and Suburban Street Railroad to the amount of $8,000 have been sold by the sheriff for $100.

Westchester, Pa.—The Westchester Street Railway Company has mortgaged the road for $30,000 to complete extensions to Lenape.

Farmington, Mo.—An electric railway to Doe Run is talked of, power to be supplied by the Hockaday-Carter Company's electric light plant.

Chattanooga, Tenn.—The Electric Car Company has been notified to put its tracks in order under penalty of the city's taking action against it.

Harvey, Ill.—The Harvey Transit Company has completed its track to Harvey for an electric railway, which is to be operated by the Short system.

Austin, Texas.—New machinery, consisting of a 350-h. p. engine and a 250-h. p. dynamo, will be put in the plant of the Austin Rapid Transit Railway Company.

Atlanta, Ga.—Mr. C. J. Simmons has been granted the privilege by the county commissioners of running an electric line from the city to the new suburban town of Cattahooches.

Sandusky, O.—The People's Electric Street Railway Company has ordered six new cars for the line and contracted for eight 25-h. p. motors. The line will be pushed to completion.

Denison, Tex.—The Denison Street and Suburban Railway Company has acquired the street railway property of the Denison Land and Improvement Company for a consideration of $75,000.

St. Thomas, Ont.—The Edison Electric Light Company, of Toronto, is organizing a company here, and is negotiating with Messrs. Hendrie, of Detroit, owners of the local street railway, to run cars by electricity.

Petersburg, Va.—Mr. George Beadle, proprietor of the Petersburg Street Railway and president of the Petersburg & Asylum Railroad, writes us that he has decided to equip both systems with electricity. The work will be started this winter.

Jacksonville, Fla.—The St. John's Shore & Panama Park Belt Line Company and the Jacksonville & Panama Park Rapid Transit Company have applied to the City Council for franchises to build and operate electric railroads through the city.

San Diego's Car Lines.—It is announced that the entire system of the San Diego, Cal., street car lines, embracing several miles of track operated by horses, has been purchased by A. B. Spreckels, who will at once convert the main portion of the system into an electric railway.

The Oakland Consolidated Street Railway Company, of Oakland, Cal., held its first meeting recently since the consolidation. It is the old electric road, whose franchises were recently consolidated and the road and the plant turned over to a new company. New officers were elected. H. L. Coleman was elected superintendent, and Mr. Beggs, formerly receiver of the Powell Street Cable Road, San Francisco, was elected secretary *vice* H. S. Hunt, who resigned.

More Electric Lines.—It is stated that there will be a large number of electric roads in Oakland, Cal., in a short time. The Telegraph avenue road is to be changed into an electric road, and it is announced that all the contracts for the electric road from Oakland to Haywards have been let. The only trouble is in the securing of the rails. Deeds for the land for the power house have been pre-

pared, and contracts for the building, machinery and wires have been let. The road will be completed as soon as the rails can be obtained.

Winnipeg, Manitoba.—The corporation of this city is calling for tenders from parties desiring to construct, own and operate a system of electric street railways in the city. The city engineer is in receipt of several requests for copies of the by-law giving the basis on which the council is willing to grant a franchise for the introduction and operation of such an electric service of street railways. Mr. Boggs, who is a prominent promoter of the Duluth system, is at present looking over the ground, and speaks as if his associates were inclined to make an offer.

New Westchester Railroad.—The Williamsbridge, Woodlawn & Westchester railroad is the name of the proposed new railroad which, it is stated, is to run to Mount Vernon, Williamsbridge and Fordham, N. Y. It is thought by those residing along the proposed route that the road is to be a branch, or feeder, to the new electric road which is to run from Yonkers to the Sound, and which is to be built by the Thomson-Houston Electric Company, the franchise for which has already been secured and the consent of property owners for the major portion of the right of way of the road.

The Street Railway as a Developer.—A recent issue of the *News*, published at Savannah, Ga., had the following: "The street railway is a great developer. It makes its own business. The rapid building of street railways in Savannah is an illustration of this fact. A dozen years ago patrons of the mule cars, the only street car then in operation, never dreamed of seeing electric roads in operation that would carry them from one side of the city to the other and out into the suburbs—two, four or six miles—for a nickel. The Belt Line, built three years ago, has done and is doing a marvelous business and it is increasing every day. The new electric line, when its extensions have been built, promises to rival even the Belt in traffic."

GENERAL APPLICATIONS OF POWER.

Milwaukee, Wis.—It is stated that the Villard syndicate is considering a proposition to erect a large building equipped with electrical power, for the accommodation of small manufacturers.

Savannah, Ga.—A project is being agitated to utilize the water power of the Canoochee River at a point about 25 miles from Savannah, to run dynamos and transmit the electrical energy over a system of wires to the city. Surveys, recently made by a civil engineer, show a fall of at least 40 feet, and it is claimed that fully 9,000 h. p. can be developed. It is proposed to begin with a plant of 2,000 h. p. Arrangements have been made to put the project in such a shape as to bring it more prominently before capitalists, with a certainty of bringing it to a successful issue.

Turning Water Into Power.—The announcement comes from Pomona, Cal., that the San Antonio Electric Power Company has been organized with a capital stock of $80,000, for the purpose of utilizing the water power in the cañons in that region. Contracts have been let for digging a tunnel 1,200 feet into the sandstone mountains for the purpose of developing 1,600 inches of water. This water will be used for generating about 1,100 h. p. for furnishing electric power and electric lights for Pomona, Chino, Ontario, etc. The erection of several factories in Pomona at an early day to use electric power is talked about. The Chino beet sugar factory will use 150 h. p. from the electric company.

LEGAL NOTES.

In the test case involving the right of the city of Crawfordsville, Ind., to erect a municipal electric light plant, the State Supreme Court has decided that towns can own and operate their own electric light plants.

Suit has been brought by Martha E. Clark, of Boston, against the Giant Electric Motor Company, of Portland, Me., and real estate has been attached for $4,000 to secure the payment of a promissory note for $3,000 alleged to be due.

A Bill in Equity has been filed in the Circuit Court by the Edison Electric Light Company against Henry T. Paiste, of West Chester, Pa., alleging an infringement by the defendant on patented improvements in sockets or holders for electric lamps. The improvements, it is stated, were invented by Edward H. Johnson, Sigmund Bergmann and Thomas Alva Edison and the patents assigned to the company. It is alleged that Mr. Paiste has manufactured sockets or holders of a similar kind without license from the complainants.

The Electric Gas Lighting Company, of Boston, a corporation chartered under the laws of the State of Maine, has filed a bill in equity in the United States Circuit Court for the Eastern District of Pennsylvania, against John Y. Parke, of Philadelphia, to restrain him from manufacturing certain electric gas lighting burners, which it alleges infringe letters patent No. 225,071, issued March 2, 1880, to Henry F. Packard, now owned by the Electric Gas Lighting Company. In the Packard burner the gas is lighted by an electric spark produced by the making and breaking contact of two electrodes; the gas is turned on by pressing or pulling down, and then releasing a lever fitted loosely to the stem of the cock, which causes a vibratory arm to sweep past the tip of the burner, and brings in contact the electric points; by this means the spark is produced which ignites the gas. The Packard patent is alleged to be the first granted for this class of burner, and has been before sustained by the United States courts in infringement suits in which it was involved. An injunction and accounting is asked for by the complainant.

EDUCATIONAL NOTES.

DEPARTMENT OF ELECTRICAL ENGINEERING,
SIBLEY COLLEGE, CORNELL UNIVERSITY, Nov. 14, 1891.

The "Crank," the college journal of engineering, appeared this fall in an improved form over last year.

The University opened this fall with an increase of about 11 per cent. over last year, while the increase of the entering class is about 20 per cent.

Of the Students in the College about one-half are taking the electrical engineering course, while the majority of the other half are taking the course in mechanical engineering.

Among those representing the college at the Frankfort Exhibition during the summer were Prof. Nichols, Mr. Merritt, and Floy and Perkins of '91, and Platt of '92.

Mr. Floy, of last year's graduating class, has returned this year and is doing some post-graduate work. He is making a study of Frölich's method of the determination of alternating current waves by means of the telephone which was brought out at the Frankfort Exhibition.

The following instruments have been recently purchased by the University: A 15 and 100-ampère Weston direct reading ammeter, a 150 and 600-volt Weston direct reading voltmeter, a one-third microfarad condenser, a multicellular voltmeter reading to 160 volts, and a D'Arsonval galvanometer for measuring resistances.

The electric lighting system for the University buildings was remodeled and enlarged between the closing of the University in June and the opening this fall. The system, as it now stands, is one of which the University should feel proud, and is due to the efforts of Dr. Thurston and Prof. Ryan, by whom it was designed and put into operation. The power for the lighting is obtained from turbine wheels placed in the gorge at the side of the Sibley buildings, and is transmitted to the main shaft by a wire cable running over 11-foot sheaves. In case of the failure of the water power, the shafting is so arranged that either the 175-h. p. triple expansion Corliss engine, now in construction, or a 60-h. p. tandem compound Lansing engine, or a straight line engine, may be belted to the main shaft. Between the dynamos and the main shaft a countershaft is placed, thus enabling the engineer to throw on or off the water or steam power without interfering with the operation of the other portions of the plant. In the dynamo room are placed a No. 12 Edison incandescent dynamo, a Westinghouse arc machine furnishing current at 1,800 volts, also an alternator of the same make, which furnishes current to the incandescent circuit of 1,000 volts. In this room also is a Westinghouse exciter, a large switchboard and various ammeters and voltmeters. From the dynamo room to Sage College an underground cable of 8,000 ft. of No. 6 wire is laid, and leading off from this is 1,500 feet of No. 10 wire to the Library and Morrill Hall. The wire used was insulated to be worked up to 2,500 volts, and was furnished by the Standard Underground Cable Company. There are 950 lights in the library. The converter capacity of this building is 360 lights, which is expected to be sufficient to light all portions of the building which may be used at one time. In Sage College there are 360 lights with a converter capacity of 320 lights. The converters used are 40-lighters, with 1,000 volts in the primary and 50 volts in the secondary, and were made by the National Electric Manufacturing Company, of Eau Claire, Wis. The wiring in the library and Sage College is concealed as far as possible, okonite wire being used. In Sage College all the wires running across joints were protected by interior conduits, and those between joints were protected by a high degree of insulation. The wiring for these two buildings was put in by the American Electric Supply Company of Buffalo. F. J. P.

Electrical Engineering at the University of California.—Prof. Hesse, of the Mechanical Engineering department of the University of California, Berkeley, is arranging for a chair of electrical engineering.

The Department of Electrical Engineering of the University of Minnesota, Minneapolis, Minn., is making large additions to its equipment. Two Edison motors have recently been received, which are used with the 10-kilowatt Edison dynamo. A 9-light Thomson-Houston arc machine has been ordered, with lamps of various styles and makes. A 300-light alternator, with accessories, will be ordered soon, and many other additions to apparatus are contemplated.

PERSONALS.

Mr. C. E. Smith, formerly with the Thomson Electric Welding Company, of Boston, has resigned his position to accept of an appointment in the Navy Yard at Norfolk, Va.

Mr. Wm. H. Cull, electrician of the Hudson River Telephone Company, of Albany, N. Y., recently spent a week in New York examining the underground conduit system.

Mr. J. M. Hill, of St. Paul, Minn., has recently accepted a position with the Thomson-Houston Electric Company, and will act as the company's manager at Tacoma, Wash.

Mr. E. P. Steen, formerly a prominent electrician at Olean, N. Y., has left for Denver, Colo., where he will open an office and engage in the practice of his profession, electrical engineering.

Mr. Herbert P. Gardner, who has had charge of the Manchester, N. H., office of the New England Telephone Company, has resigned and accepted a position in New York. He is succeeded by Mr. H. I. Laighton.

Mr. N. L. Teeple, formerly with the Tucker Electric Construction Company, has accepted of a position with the Edison General Electric Company, Buffalo branch, and will represent that company in western New York.

Mr. Alexander M. Robertson, general manager of the Minnesota Brush Electric Company, of Minneapolis, and Miss Amy E. McDonald were married in that city on Nov. 4, and are now enjoying a pleasant bridal tour.

Mr. E. H. McFall, formerly in charge of the power department of the Louisiana Electric Light and Power Company, of New Orleans, has assumed charge of the electrical department of Manion & Co., 167 Barronne street, New Orleans.

Mr. Thomas A. Jenkins, superintendent of the South Covington, Ky., and Cincinnati Street Railroad Company, has recently made a tour of the Eastern cities inspecting the latest improvements in electrical appliances for motive power.

Mr. H. C. Spaulding, formerly manager of the motor department of the Thomson-Houston company and recently connected with the mining department of the Thomson-Van Depoele Electric Mining Company, has resigned, and will engage in business for himself, acting as independent consulting engineer. His many friends will wish him every success in his new departure.

Mr. W. H. Archer, architect, 20 Morgan Building, Buffalo, N. Y., has been appointed architect for the Buffalo, Tonawanda & Niagara Falls Electric Railroad, now in course of construction. He is architect of a large number of the most prominent buildings of Tonawanda, some of which are the Young Men's Christian Association Building, Kohler's Theatre, First Presbyterian Church, Higgins Hotel, Chas. Williams Block and Union School No. 3 Annex.

MISCELLANEOUS NOTES.

The Number of Electric Lighting Plants established in the South during the past nine months, it is stated, is 124.

The Canton Steam Pump Company, of Canton, O., and the J. H. McLain Machine Works suffered severely from fire on the 8th inst., but are working hard to repair the disaster.

The National Conduit Company, of New York, it is stated, has procured a site gratis in East St. Louis, Ill., on which the company has agreed to erect a manufacturing establishment and have it in working order by March next.

Electric Engines to be Used.—At a recent meeting of the stockholders of the Denver, Lakewood & Golden Railroad it was determined that electric engines shall be used, and orders have been issued for them to be delivered as soon as possible. The line is to be built and run by electric engines from Denver to Salt Lake.

The Boston and Montana Mining Company, of Great Falls, Mont., it is stated, will issue $600,000 in bonds for the purpose of constructing an electrolytic plant at Great Falls, Mont., for the purpose of refining its output of copper by electricity, thereby saving large sums of money by the extracting of silver contained in its output.

Industrial and Trade Notes.

Manion & Co., of New Orleans, La., will handle the Columbia incandescent lamp and a few other specialties, having added an electrical department to their business.

Mr. W. H. Archer, architect, 20 Morgan Building, Buffalo, N. Y., has prepared plans for seven depots for the Buffalo, Tonawanda & Niagara Falls Electric Railroad.

Mr. J. H. Phillips, of the Chesapeake Belting Company, of Baltimore, Md., reports having recently received an order from San Francisco for over $7,000 worth of belting manufactured by his company.

The Viaduct Manufacturing Company, of Baltimore, Md., of which A. G. Davis is president, reports business as being good and prospects very encouraging. Payments are slow and promises are not well kept.

Mr. W. T. Morgan, treasurer of the Automatic Switch Company, of Baltimore, Md., reports that his company will bring out some new specialties about the first of the year, in addition to some improvements on their switch.

The Thomson-Houston Electric Company is distributing a very neat descriptive pamphlet of the Roundhay Electric Tramway, which has been installed by the company at Leeds, England. A description of the road is given in this issue of THE ELECTRICAL WORLD.

Mr. J. L. Chapin, of 24 West Fourth street, New York, put in the cresent referred to in the description given in THE ELECTRICAL WORLD last week of the electric lighting effects of the Madison Square Garden. Mr. Chapin has done a large amount of work in this line and also in putting in ventilating apparatus.

The New York & Ohio Company, of Warren, O., manufacturer of the Packard high grade incandescent lamp, has transferred the Chicago agency to the Electrical Engineering and Supply Company, No. 931 "The Rookery," which will immediately lay in a stock of Packard lamps so that all orders can be filled from stock.

The Manhattan Electrical Supply Company, of 36 Cortandt street, New York, has issued a new illustrated catalogue and price list of electrical supplies. It consists of 152 pages, attractively got up, alphabetically arranged and indexed for ready reference. It gives a complete list of the electrical specialties manufactured by the company.

The Duplex Street Railway Track Company, of 51 Wall street, New York, has commenced laying a duplex track on the Fourth avenue line of the New York and Harlem Street Railroad. The mechanical principle of under and overlapping at joint connections is new in its application to street railway tracks, and the duplex system attempts in a simple and natural way to overcome the inherent weakness at joints of all other street railway tracks.

Mr. Benj. Sebastian, Jr., formerly connected with the Sebastian-May Company, of Sidney, O., having recently severed his connection with that company, has resumed business in Cincinnati under the name and style of the Sebastian Lathe Company, of which he is the sole proprietor. He has started his business at 41-45 Central avenue, for the manufacture of foot and power lathes, etc., and has equipped the works with all the latest improved machinery, for the manufacture of the best grades of the tools referred to.

The E. S. Greeley & Company, of 5 and 7 Dey street, New York, is placing on the market a patent door knob alarm bell, designed as a safeguard for stores, offices, private apartments and general use. It may be applied to the knob, either inside or out, of any door where it is desirable to have a signal given at any attempt at entry, whether the door is locked or not, and a half turn of the knob in either direction will ring a signal giving notice within. A small lever attached to the bell secures silence when desired. It is three inches in diameter and about one half inch in thickness, capable of ready application, and not conspicuous when applied. No wires or batteries are employed. It is entirely mechanical and complete in itself.

Gooding, Beinert & Co., of 80 John street, New York, made arrangements some time since, when the Empire City Electric Company, of 15 Dey street, was closing out its business, to continue its repair work, It is the intention of Gooding, Beinert & Co. to make a special effort in the repair of gas igniters, and also a specialty of repairing dynamos and motors, and they have established a route throughout the city for looking after and keeping in running order dynamos and motors. In the fall they are prepared to house all fan motors and outfits for the winter, and erect the same in running order in the spring, and also to do experimental work of all descriptions in the electrical line, such as mechanical and electrical bell work, speaking tubes, and to furnish estimates on the same.

A New Radial Truck.—A new radial truck for street railways, the invention of Mr. Henry F. Shaw, has been brought out by the Shaw Manufacturing Company, of Boston. It is described as extremely simple and the radial attachment as absolutely exact in its movements mechanically, and especially adapted for electric cars on curves of short radius, lessening the power required in turning curves. The forward truck consists of four wheels, and the rear of two wheels only. Of the four-wheel truck, the two middle or rear wheels are much the smaller and serve as guides to keep the larger wheels from leaving the track. Each truck is made to move around its own centre to meet any curvature in the track, the movement of the following wheels being guided by that of the forward wheels. Recent tests have been made of this device, which were witnessed by practical railroad men, and it is regarded as very ingenious and valuable mechanically.

A visit to the works of the Ball Engine Company, of Erie, Pa., manufacturers of automatic cut-off engines, would convince the visitor of two facts: First, that the Ball Engine Company has splendid facilities for building high speed engines, and second, that the electric street railway and electric lighting interests appreciate first-class work, as the works of the Company are crowded with business. During the past spring the company has built an entirely new machine shop, fitted out with the very best of modern machinery. This building is well arranged and exceedingly spacious and well lighted and largely increases the capacity of the works, besides giving facilities for doing a better class of work than in the past. In view of the fact that business is said to be dull all over the country, and in spite of its largely increased facilities, the Company is crowded with orders for months ahead, and running its works night and day, with no indications of any let-up during the winter. The Company looks for a still larger business during the coming year. The orders received come from no particular section but from all over the country.

Business Notice.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED NOV. 10, 1891.

462,681. Electric Conductor; John A. Barrett, of Brooklyn, N. Y., Assignor to the Standard Underground Cable Company, of Pittsburgh, Pa. Application filed Jan. 8, 1891. A conductor having a fibrous or meshed air-containing serving about it, a sized envelope surrounding the served conductor, and sealing material outside the envelope.

462,688. Electric Railway System; Henry C. Camp, of St. Paul, Minn. Application filed June 30, 1890. The combination in a conduit for the conductors of electric railways, of the side walls of the conduit at a greater distance apart than the proposed width of the slot, inwardly extending lugs formed at the upper edge of said side walls, angular cap plates having one wing adjustably secured to said lugs, and forming chambers upon each side of the upper interior of the conduit, and current conductors suspended from said lugs in such manner as to lie above the plane of the lower edges of said depending wings.

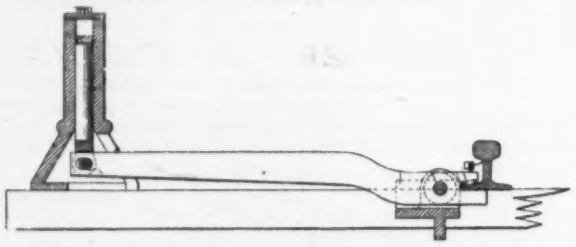
462,693. Secondary Battery; Nathan H. Edgerton, Philadelphia, Pa. Application filed Jan. 24, 1891. In an electric accumulator, a main containing cell or jar filled with an electrolytic liquid, in combination with a battery of electrodes arranged in sets of three each, each electrode contained within and insulated from a metallic cell filled with active material and contained within said main cell or jar, the central electrode in each set being of different polarity from the other two in each set, and electrical connections between the electrodes of different polarity in the several sets.

462,698. Electric Arc Lamp; John E. Giles, of Hazleton, Pa., Application filed Jan. 29, 1891. A cut-out for an arc lamp, provided with changeable connections, one set including the cut-out magnet in the main circuit, thereby opening the shunt circuit on cessation of the main current, the other set closing a by-pass around the regulating coils when the main circuit is interrupted, whereby the lamp may be used on constant potential or constant current lighting systems.

462,707. Device for Removing Ice from Overhead Wires; George Hipwood, of Boston, Mass., Assignor of two-thirds to Francis F. Bibber and Horatio C. Barrett, of same place. Application filed Aug. 24, 1891. A trolley-pole, in combination with a lever pivotally supported thereon and bearing a hammer in position to contact with the overhead conducting-wire and mechanism.

462,720. Telegraph-Table; Katie V. Miller, of Lewisburg, O. Application filed Sept. 23, 1890. This invention consists of a table frame and revolvable table top adapted to carry telegraph instruments, one of the parts carrying pairs of insulated contact rings and the other carrying pairs of insulated contact devices, each ring having electrical connection in all its positions with one and only one contact device, pairs of instrument wires secured to one set of the co-operating contacts, and pairs of line wires secured to the other set.

462,732. Electric Belt; Per Erick Petterson, of Minneapolis, Minn. Application filed March 11, 1891. The combination, with a supporting belt, having contact plates arranged at regular distances around the same, of a pocket having upper and lower flaps, the longitudinal strips secured to the back of the pocket and adapted to fold up over the fronts of the chains, means for securing said flaps and connections between the ends of said battery chains and said contact plates.



No. 462,850.—Electric Circuit Closing and Breaking Device for Railway Tracks.

462,741. Police Signal Telegraph System; Charles A. Rolfe, of Chicago, Ill. Application filed March 9, 1891. In police signal telegraph systems, a street signal station comprising a sentry box having an entrance door which can be opened and closed by properly authorized officers, and a signal case arranged upon the inner wall of the sentry box and provided with a signal mechanism accessible for the purpose of sending signals both from the interior and the exterior of the sentry box, said sentry box being adapted to permit access to be had from its exterior to an operating member of the signal mechanism at the back of the signal box, and the signal mechanism being arranged to be available for all of its uses to authorized officers who may enter the sentry box, and having an operating member at its back also available for certain uses from the outside of the sentry box both to said officers and to the holders of citizens' keys to whom access to the interior of the sentry box may be desired.

462,751. Electric Railway Motor; Charles J. Van Depoele, of Lynn, Mass. Application filed Dec. 20, 1890. In an electric locomotive, the combination, with the driving axle and wheels fixed thereto, of an armature fixed upon and carried by said axle, a circular field-magnet surrounding said armature; also carried by the axle and journaled thereon, and means carried by the armature for shifting the polarity of the field, in advance of the poles of said armature. (See illustration.)

462,756. Carbon-Holder for Arc Lamps; James J. Wood, of Brooklyn, N. Y., Assignor to the Fort Wayne Electric Company, of Fort Wayne, Ind. Application filed Dec. 10, 1890. A carbon-holder consisting of a hollow shell, two clamping jaws adapted to grip the carbon between them at their lower ends and terminating at their upper ends in contact with the internal surface of said shell, reacting against one another and adapted to tilt in clamping the carbon, and a tightening device for acting on said jaws to press their lower ends together and their upper ends.

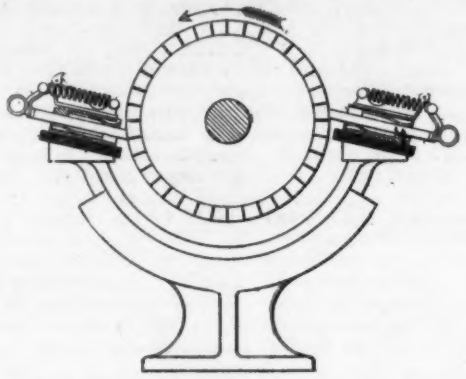
462,785. Call-Box; Edmund R. Wilder, of Kansas City, Mo., Assignor to the Wilder Duplex Electric Burglar Alarm and Messenger Company, of West Virginia. In a call-box, the combination of a signaling mechanism, a starting mechanism in a normally broken circuit, a hand switch in the box, a metallic circuit of two conductors connecting the box and station and a battery in such circuit which supplies a continuous normal current, a ground-circuit composed in part of one or both of the conductors of such metallic circuits and containing an independent battery which may supply a current heavier than the normal current, said switch adapted to control the ground circuit so as to momentarily complete the same over either or both the metallic conductors, and thus by such heavy battery start the box, said starting mechanism in such switch-controlled circuit adapted to release the signaling mechanism and said signaling mechanism adapted to be connected with either the metallic or ground circuit, so that by the action of the switch the heavy battery on the ground circuit starts the box and the signal is given.

462,786. Fire-Alarm Box; Edmund R. Wilder, of Kansas City, Mo., Assignor to the Wilder Duplex Electric Burglar Alarm and Messenger Company, of West Virginia. Application filed Jan. 2, 1891. In a fire-alarm box, the combination of a circuit connecting the box with the central station, a signaling device in such circuit, a driving mechanism for the same, a locking device for such driving mechanism, a portion of which device is in said circuit, a generator connected and normally supplying a constant current of a given quantity to such circuit, means for adding to such current in the same circuit, said releasing mechanism adapted to respond to such changes in the strength of the current thus applied to such circuit, said locking device containing an electro magnet, an armature, and a wheel, with a notch, a stop for the driving mechanism controlled by such electro magnet, and a mechanical stop adapted to be moved by the operator when the box is set in motion.

462,793. Electric Car Brake; James Dallas Collier and James K. Polk Miller, of Woodville, Tex., Assignors of one-third to John H. Kirby, of same place. Application filed Feb. 4, 1891. In an electrical system for use on continuous trains, a circuit coupler for connecting the wires from car to car, consisting of two blocks of insulating material, the one block adapted to fit snugly in a recess in the other block, both blocks being perforated with wires terminating in contact pieces correspondingly arranged on the faces of said blocks in contact with each other, said blocks being attached to different cars, and being pressed together by a spring or springs.

462,794. Electrical Connection and Signal for Railway Cars; James Dallas Collier and James K. Polk Miller, of Woodville, Tex., Assignors of one-third to John H. Kirby, of same place. Application filed March 25, 1891. In a railway train, the combination, with a source or sources of electricity, of two main wires connected to opposite poles of the source of electricity leading throughout the train and electrically connected from car to car by circuit couplers on either side of the draw-head; a series of secondary wires branching at either end of the car and symmetrically connected from car to car by the said circuit couplets, each of said wires being connected to one of the mains and to a device operating by electricity, and a series of circuit closers attached to the opposite main and capable of connecting the secondary wires therewith.

462,795. Method of Producing Rainfall; Louis Gathmann, of Chicago, Ill. Application filed July 16, 1891. The method of producing a rainfall, consisting in condensing the moisture in



No. 462,883.—Brush-Holder for Dynamo-Electric Machines.

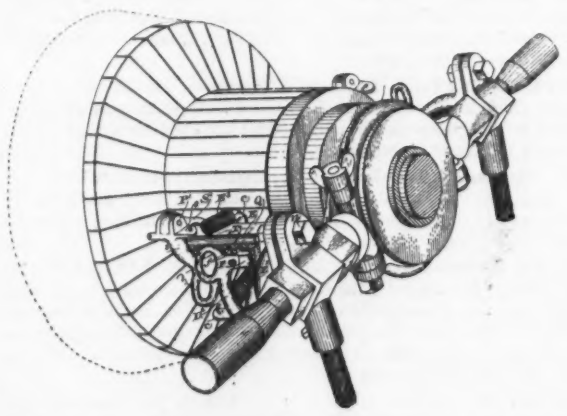
the atmosphere by suddenly lowering the temperature of the same by the rapid evaporation of highly compressed gas.

462,807. Electric Car Coupling; James Dallas Collier and James K. Polk Miller, of Woodville, Tex., Assignors of one-third to John H. Kirby, of same place. In a system of car couplings actuated by electricity, the combination, with the source of electricity, of a conductor leading from one pole thereof connected from car to car, a second conductor leading from the opposite pole of the source of electricity and also connected from car to car, an electromagnet and circuit closer between the said conductors, and an armature adapted to be drawn to said magnet, a link connected to the draw head and having an arm protruding therefrom, a rod or rods connecting said arms and said armature to raise the link, and means for engaging said link in the opposite draw head.

462,808. Police-Signal System; Nathaniel Banks Cregier, of Chicago, Ill., Assignor of one-half to De Witt C. Cregier, Sr., of same place. Application filed Nov. 26, 1889. In a signaling system, the combination, with a central station, a street box connected therewith by a closed electric circuit, and a drop and a magneto-bell signal at the station, both included in said circuit and operating as described, of a mechanical generator, and a local battery, both also included in said circuit at the box for producing currents of different characters in said circuit, and a switch at the box for throwing said battery into the closed circuit for operating the visual signal at the station.

462,834. Signaling Device for Elevators; Charles G. Armstrong, of Chicago, Ill., Assignor of one-half to Dankmar Adler, of same place. Application filed Jan. 17, 1891. The combination, with an elevator shaft and car, of a visual signaling device located within the shaft, an audible signaling device, also located in the shaft, and means for actuating said signaling device, embracing a push-button or equivalent device located at a doorway of the shaft side of the latter, and operative connections extending from the said push-button through the wall of the shaft to said signaling devices.

462,835. Electrical Indicator for Elevators; Charles G. Armstrong, of Chicago, Ill., Assignor of one-half to Dankmar Adler, of same place. Application filed March 10, 1891. The combination, with an elevator shaft having a plurality of doorways, an elevator and its actuating mechanism, of an indicating device comprising a battery or other source of electricity, a plurality of indicators, one located at each doorway, and each consisting of a



No. 462,973.—Brush-Holder for Dynamo-Electric Machines.

plurality of electro-magnets equal in number to the indicators, an index or pointer, a dial having characters indicating the several doorways, and a movable armature, connected with and actuating said pointer, conductors forming a plurality of circuits, each of which includes one magnet of each indicator, and a commutator or circuit-closer actuated by a moving part of the elevator mechanism, and which operates to successively close the said several circuits during the movement of the elevator.

462,836. Mechanical Cut-Out; Harry W. Burnet, of East Orange, N. J. Application filed April 7, 1891. In combination with the other operating parts of an electric switch segment presenting successively in the path of the relatively moving contact of the switch an insulating deflecting face, a conducting deflecting face and an insulating deflecting face, a spring on the free end of the switch lever or moving arm adapted to press the moving contact against the successive faces of the said segment, a retracting device for the actuating mechanism of the switch, and a surface or notch between the first and second of said deflecting faces on the said segment adapted to prevent a backward movement of the switch-contact from the second to the first of said faces.

462,850. Electric Circuit Closing and Breaking Device for Railway Tracks; Thomas H. Patenall, of Rahway, N. J. Application filed Feb. 20, 1891. The combination, with a reciprocating plunger under the control of a railway rail, of a receptacle for a fluent electric conductor, said receptacle having separated branches, one of which is in communication with an air chamber at the end of the plunger through an inclosed channel, and contact points located in position to engage the fluent conductor. (See illustration.)

462,880. Commutator; Sidney H. Short, of Cleveland, O. Application filed May 26, 1891. In a commutator, the combination with a sleeve having an annular flange formed on one end thereof and integral therewith and an adjustable flange encircling said sleeve, both of said flanges being constructed with inwardly converging inclined or beveled faces of different angles of inclination, of commutator bars having beveled ends conforming to the inclined bearing faces on said end flanges and a nut for securing the parts in place.

462,881. Armature for Dynamo-Electric Generators; Sidney H. Short, of Cleveland, O. Application filed June 12, 1891. A ring armature consisting of a laminated core constructed of ribbon wound upon itself, bobbins wound upon the core and blocks or separators of non-magnetic material secured between the bobbins near the edges of the armature core, thereby forming open air spaces between the blocks and also insuring open air spaces between the sides of the bobbins.

462,882. Armature for Dynamo-Electric Machines; Sidney H. Short, of Cleveland, O. Application filed June 19, 1891. A ring armature comprising a laminated core slotted at its opposite edges, forming teeth, bobbins wound between the teeth, and flat magnetic rings secured to the sides of the armature outside of the bobbins.

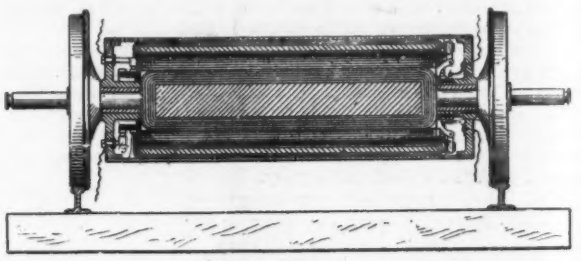
462,883. Brush-Holder for Dynamo-Electric Machines; Sydney H. Short, of Cleveland, O. Application filed July 6, 1891. A brush holder provided with bearings on opposite sides of the brush rod or plate, one in advance of the other, and springs pressing the rod or plate against said bearings. (See illustration.)

462,901. Duplex and Quadruplex Telegraphy; Francis W. Jones, New York. Application filed Nov. 11, 1885. In a duplex or quadruplex telegraph apparatus, the combination, with the device for preventing mutilation of signals received on the neutral relay at the instant of reversal, of an induction apparatus whose secondary is connected with such devices, while its primary consists of two coils, one in the main and the other in the artificial line.

462,926. Heating and Lighting System; Rudolph M. Hunter, of Philadelphia, Pa., Assignor to the Electric Car Company of America, of same place. Application filed Jan. 12, 1887. In an electric railway, the combination of a line working conductor arranged along the track, an electrically propelled vehicle, a motor on said vehicle, two secondary batteries also on said vehicle, a current collector carried by the vehicle to receive current from the line working conductor, a motor-circuit, a secondary-battery circuit in electrical connection with said motor circuit, and switches to cut either battery out of circuit and disconnect it from the line circuit, a local circuit carried by the vehicle, a switch to couple said circuit with either of the batteries, and translating or current consuming devices.

462,973. Brush-Holder for Dynamo-Electric Machine; Elihu Thomson, of Swampscott, and William O. Wakefield, of Lynn, Mass. Application filed Feb. 20, 1891. The combination of a commutator yoke having radially projecting pins, insulating sleeves on said pins, clamps radially adjustable on said sleeves, and brush-holders carried by said clamps. (See illustration.)

463,001. Electrical Annunciator; Joseph Brodie Smith, of Manchester, N. H., Assignor to the Electric Gas Lighting Company, of Maine. Application filed Aug. 21, 1889. In an electrical annunciator, the combination of two electric circuits, a movable plug or push button adapted and arranged to close either circuit,



No. 462,751.—Electric Railway Motor.

an electromagnet forming in turn a part of each circuit, a vibratory armature, a pawl-and-ratchet mechanism actuated by said armature, and a visual indicator carried by the ratchet.

463,020. Electric Railway System; Granville T. Woods, of New York, Assignor to the American Engineering Company, of same place. Application filed Aug. 31, 1891. In electric railways, a system of electrical distribution composed of a group of electromagnetically controlled contacts outside of the roadbed, and accessible, each contact being electrically connected with one exposed terminal head in the roadbed.

463,024. Reversible Electric Trolley; Joseph Wm. Bates and Carlostine Erastus Blake, of Minneapolis, Minn. Application filed Dec. 22, 1890. The combination, with a trolley wheel, of an oscillating reversing frame provided with laterally flared guides, the outer ends of which are made to converge and form a bearing or point of contact for the trolley wire, the said guides serving as directors of the trolley upon the trolley wire, both on the right and left hand sides of the axis of the trolley.

463,035. Electric Arc Lamp; James E. Gaston, of Sparta, Ill. Application filed Jan. 15, 1891. A carbon holder for electric arc lamps, consisting of two semi-tubular jaws suitably pivoted intermediate of their ends to a block within the interior thereof and adapted to receive the carbon at one end, a screw threaded rod carried by said block, and a tapering plug upon said rod extending from the other end of the device, whereby the carbon may be gripped and released by turning said plug in one or the other direction.

463,036. Electric Safety Cut-Out Device; Addison G. Waterhouse, of Hartford, Conn. Application filed June 24, 1891. A cut-out mechanism provided with terminals which are electrically connected to the extremes of the field-magnet coil or coils of a dynamo-electric machine with an electro-magnet placed in the circuit of said machine having a movable armature provided with a plate or bridge capable of electrically connecting said terminals, said armature being provided with a dash-pot or retarding mechanism, a prop or hook for supporting said armature, adapted for withdrawing its support when the current energizes the said electro-magnets.

463,072. Station-Indicator; Joseph M. Nelson, of Coleman, Mich. Application filed May 14, 1891. In an indicator, the combination, with the casing and indicating device, of a motor for actuating the indicating device, means for reversing the movement of the indicator, and a double latch for limiting the movement of the same governing the movement of the motor.

463,079. Electric Conductor; Charles T. Snedekor, of New York. Application filed May 8, 1891. An insulating covering for electric conductors, consisting of a rubber covering, an adhesive substance upon the rubber covering, a powdered refractory material over the adhesive substance, tape saturated with a silicate, and a suitable finish over the tape or braid.

463,107. Electric Conductor; Frederick E. Degenhardt, of Chicago, Ill., Assignor to The Standard Underground Cable Company, of Pittsburgh, Pa. Application filed Sept. 1, 1890. The combination of a conducting-wire and a strip provided with alternate elevations and depressions surrounding said wire, thereby forming receptacles for the retention of air.

463,121. Steam Dynamo-Electric Machine; Frank M. Garland, of New Haven, Conn. Application filed Feb. 4, 1891. In combination in a steam dynamo, a base having a mount at its centre for an electromagnet and standards rising from the upper surface each side of the centre, said standards being hollow at their lower part and provided with a plane surface upon the exterior of the hollow portions and shaft bearings at their upper ends, cylinders bearing pistons held to the plane surfaces on the standards, a shaft bearing an armature supported in the bearings and connected at each end with the pistons, and a field magnet supported by the base.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.